



UNIVERSIDAD  
DE LOS ANDES  
MERIDA VENEZUELA

# Influencia de la morfología del relleno en las propiedades mecánicas de las resinas compuestas contemporáneas

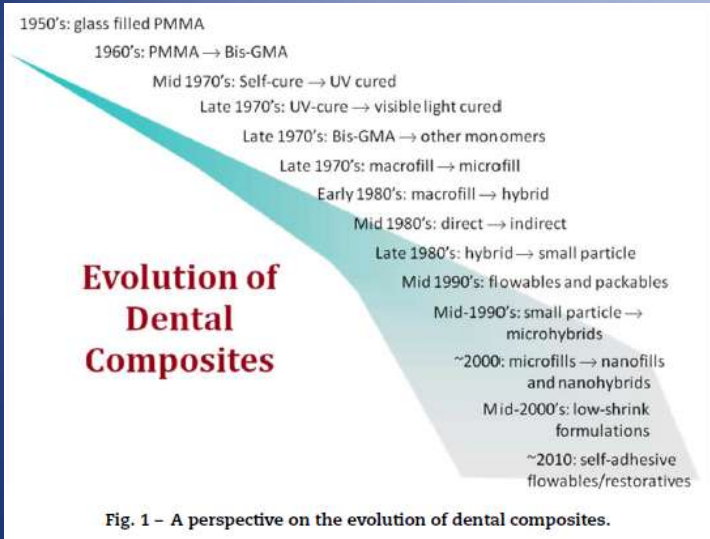
**Od. Robert A. Ramírez M.**  
**Universidad de Los Andes.**  
**Odontología Restauradora.**  
**Cátedra de Operatoria Dental.**

# ¿Por qué han evolucionado las resinas compuestas?

Alta versatilidad

- Materiales restauradores.
- Forros cavitarios.
- Selladores de puntos y fisuras.
- Reconstrucción de muñones.
- Inlays, Onlays y Coronas.
- Restauraciones provisionales.
- Cementación de prótesis simples ó múltiples.
- Fijación de dispositivos de ortodoncia.
- Selladores endodónticos.
- Cementación de postes.

# Evolución de los últimos 50 años



## **Matriz polimérica.**

Enfocadas en reducir la contracción por polimerización, y “tal vez” el estrés por la contracción de polimerización.

**Auto-Adhesión**

**Auto-Reparación**

**Materiales que inducen repuestas favorables.**

## **Las partículas de relleno.**

El tamaño reducido mejoro la capacidad de pulido y aumentó la resistencia abrasiva

# Existen tres componentes estructurales básicos en los composites dentales:

- Matriz.
- Partículas de relleno.
- Agente de acoplamiento.



Fig. N° 2.  
Componentes fundamentales de las resinas compuestas. Esquema general donde puede verse la matriz de resina, las partículas de relleno y el agente de conexión.



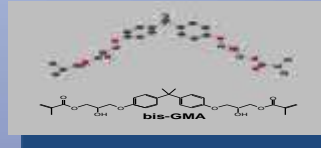
RODRIGUEZ G. Douglas R. Profesor Asociado en la asignatura Biomateriales Odontológicos del Departamento de Ciencias Básicas Odontológicas de la Facultad de Odontología de la Universidad de Carabobo.

PEREIRA S. Natalie A. Profesora contratada en la asignatura Operatoria Dental del Departamento de Prosthodontia y Oclusión de la Facultad de Odontología de la Universidad de Carabobo

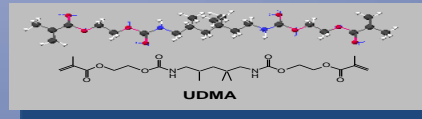
# Matriz

# Los tres monómeros más ampliamente usados para matrices basados en dimetacrilatos

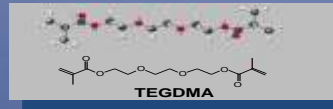
– bis-GMA (PM 512)



– UEDMA (PM 470)



– TEGDMA (PM 286) (se usa como el diluyente)



– Variaciones

“La química de los siloranes por primera vez presenta la posibilidad de valores de contracción menores al 1 %, parámetros como el módulo elástico y resistencia flexural comparable a los composites convencionales”



Weinmann W, Thalacker C, Guggeberger R. *Dent Mater.* 2005 Jan;21(1):68-74.

# ¿Que hay de cierto?

1. Poseen buenas propiedades mecánicas.
2. Inferior integridad en los márgenes cuando se compara con los nanohíbridos.
3. No genera menos estrés de contracción que otras formulaciones.

1. Ilie N, Hickel R. ***Dent Mater*** 2009; 25:810–9.  
Ilie N, Hickel R. ***Dent Mater J*** 2006; 25:445–54.
2. Schmidt M, Kirkevang LL, Hørsted-Bindslev P, Poulsen S. ***Clin Oral Invest*** 2010. July 20.
3. Marchesi G, Breschi L, Antonioli F, DiLenarda R, Ferracane J, Cadenaro M. ***Dent Mater*** 2010;26:947–53.



# Contraction stress of low-shrinkage composite materials assessed with different testing systems

## ABSTRACT

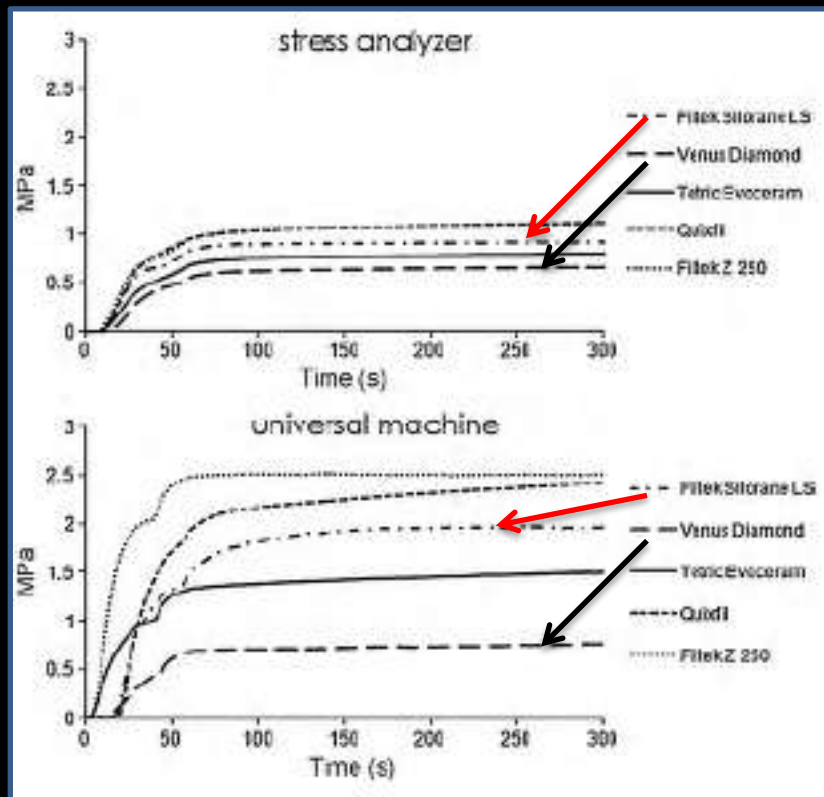
**Objectives.** The contraction stress of a silorane-based material and a new low-shrinkage nanohybrid composite were compared to three conventional dimethacrylate-based resin composites using two different measuring systems. It was hypothesized that the silorane-based material and the low-shrinkage nanohybrid composite would exhibit lower contraction stress than dimethacrylate-based composites irrespective of measuring system.

**Methods.** The materials tested were Filtek Silorane LS (3M ESPE), Venus Diamond (Heraeus Kulzer), Tetric EvoCeram (Ivoclar Vivadent), Quixfil (Dentsply DeTrey), and Filtek Z250 (3M ESPE). Shrinkage stress was assessed using a stress-strain analyzer consisting of two opposing attachments, one connected to a load sensor and the other fixed to the device, or a system fixed to a universal testing machine with an extensometer as a feedback system. All specimens were light-cured with  $20\text{ J/cm}^2$ ; the contraction force (N) generated during polymerization was continuously recorded for 300 s. Contraction stress (MPa) was calculated at both 40 s and 300 s. Data were statistically analyzed by three-way ANOVA and Tukey's post hoc test ( $\alpha = 0.05$ ).

**Results.** Venus Diamond exhibited the lowest stress under both experimental conditions. Stress values scored as follows: Venus Diamond < Tetric EvoCeram < Filtek Silorane LS < Quixfil < Filtek Z250 ( $p < 0.05$ ). Stress values measured with the stress-strain analyzer were significantly lower than those measured with the universal testing machine with feedback.

**Significance.** The hypothesis was partially rejected because only Venus Diamond exhibited the lowest stress values among the tested materials. Contraction stress was higher for all composites when measured in a test system with a feedback. This study confirms that simply reducing the shrinkage does not ensure reduced stress development in composites.

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Giulio Marchesi<sup>a</sup>, Lorenzo Breschi<sup>a,b,\*</sup>, Francesca Antonioli<sup>a</sup>, Roberto Di Lenarda<sup>a</sup>, Jack Ferracane<sup>c</sup>, Milena Cadenaro<sup>a</sup>

# Otras filosofías adoptadas para disminuir la contracción:

1. Aumentar el peso molecular del monómero para reducir la contracción.
2. Monómeros con baja generación de estrés.
3. Monómeros con un mayores niveles conversión.

1. DX511 (895 g/mole), en KALORE™, GC



2. TCD-DI-HEA, en Venus Diamond, Kulzer



3. Dimer acid monomer (673-849 g/mole), en N' Durance, Septodont

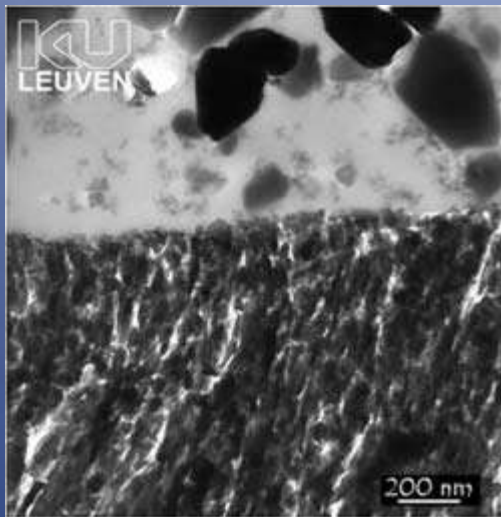
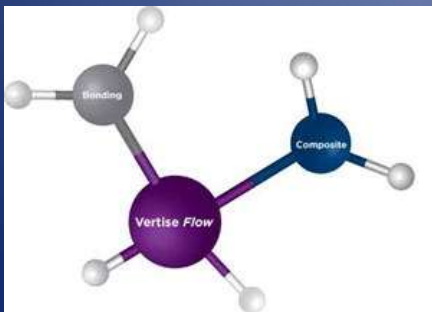




# Resinas fluidas que contienen monómeros ácidos:



- Vertise Flow (Kerr)
- Fusio™ Liquid Dentin (Penton Clinical)
- Usan los metacrilatos típicos con un monómero ácido (GPDM) capaz de generar adhesión mecánica y posiblemente química.
- Usos: forros, sellantes y restauraciones pequeñas.



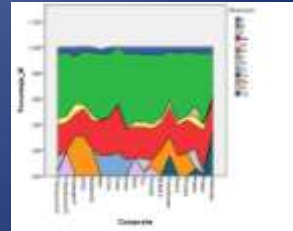
Partículas de Relleno

A microscopic image showing a dense field of small, bright blue fluorescent particles. The particles are irregular in shape and appear to be resting on a brown, textured surface. The text 'Partículas de Relleno' is overlaid diagonally across the image in a white, outlined font.

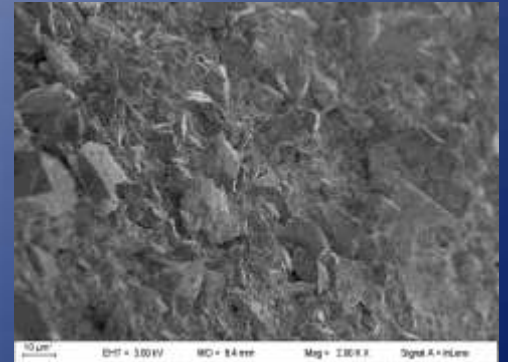
# Química de las Partículas de Relleno.

- Oxido de Sílice
- Cuarzo ó vidrio molido de 0.1 a 100 micras.
- Sílice coloidal ó piro-lítica 0.04 micras (40 nanómetros av).
- Óxidos de aluminio, zirconio, bario, zinc, boro, itrio y litio.
- Tri-fluoruro de iterbio.

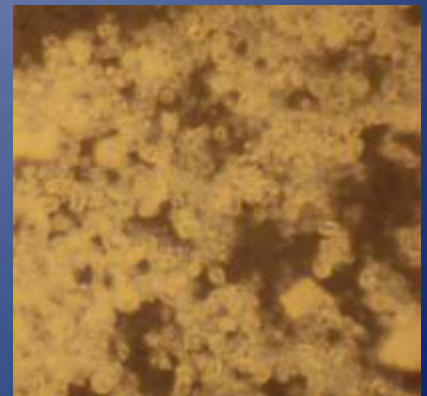
*Van Dijken 1989, Hosada y colb. 1990, Khan 1992 y Scougall-Vilchis y colb.2009*



# Beneficios de las partículas de relleno



1. Aumenta las propiedades mecánicas.
2. Reduce la contracción.
3. Disminuye la diferencia del coeficiente de dilatación.
4. Mejora la manipulación.
5. Contribuye con el Dx-Rx.
6. Mejora la estabilidad del color.



**Agente de acoplamiento**



Silanos orgánicos  $\gamma$ -  
metacriloxypropiltrimetoxisilano:

- La unión entre la matriz y el relleno, esta dada por el agente de acoplamiento.

Representa del 4,4 – 9,7% de la resina compuesta

*Journal of Oral Rehabilitation* 2004 **31**; 1090–1101

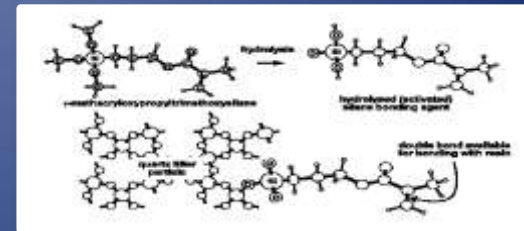
J. SABBAGH\*, L. RYELANDT<sup>†</sup>, L. BACHÉRIUS<sup>†</sup>, J.-J. BIEBUYCK<sup>‡</sup>, J. VREVEN\*,  
P. LAMBRECHTS<sup>§</sup> & G. LELOUP\* \*Department of Conservative Dentistry, School of Dentistry, Université Catholique

**Dentro de las ventajas que se  
obtienen del agente de  
acoplamiento podemos  
nombrar:**

1. Mejora propiedades físicas y mecánicas.

2. Inhibe la penetración de agua en la interfase matriz- relleno.

3. Esta relacionado con el éxito clínico de la restauración.



# Sistema Iniciador

Iniciador-Activador

Físicos

Químicos

Calor Q

Luz

I=peroxido de benzoilo + A= 2% amina terciaria aromática

Lucirin TPO

I=camforoquinona 0,06% + A=amina terciaria no aromática 0,01%)

PPD

Irgacure 819

OPPI  
"experimental"

# Otros componentes:

- inhibidores (hidroxitolueno butilado)
- modificadores ópticos (pigmentos, opacificadores y tipos de relleno)



**Clasificación de las resinas  
compuestas en relación al  
tamaño y distribución de  
las partículas.**

**Macro- relleno (10-50  $\mu\text{m}$ )**

**Micro- relleno (40-50 nm)**

**Medio- relleno (1-10  $\mu\text{m}$ )**

**Mini- relleno (0,6-1  $\mu\text{m}$ )**

**Nano-relleno (5-100 nm)**

**La mezcla ó  
combinación  
deriva en otros  
términos:**

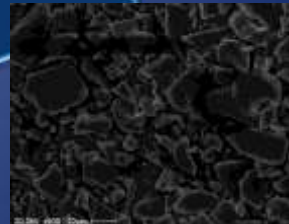
**Híbridos convencional  
(10-50  $\mu\text{m}$  + 40 nm)**

**Híbridos (1-10  $\mu\text{m}$  + 40 nm)**

**Micro-híbridos (0,6-1  $\mu\text{m}$  + 40 nm)**

**Nano- híbridos (0,6-1  $\mu\text{m}$  + 50- 100 nm)**

**Pre-polímeros**





0.025-0.075  $\mu\text{m}$   
nano-rellenos

0.4 – 0.7  $\mu\text{m}$  Luz visible

0.04 – 0.4  $\mu\text{m}$  micro-rellenos

0.4 – 1  $\mu\text{m}$  microhíbrida

0.5 – 3  $\mu\text{m}$  híbrida

Nano-híbrido

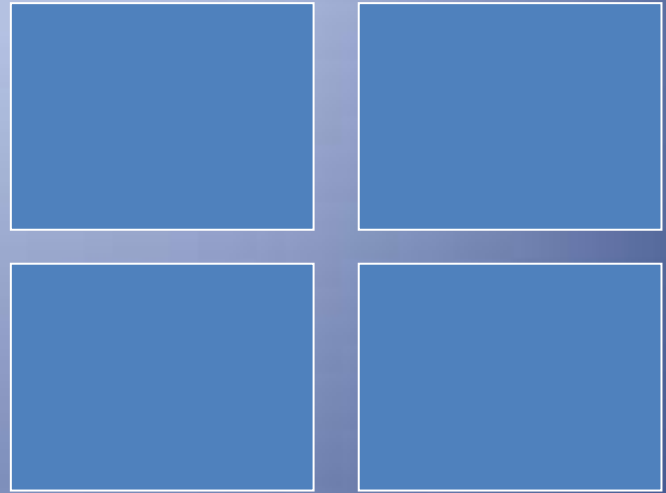


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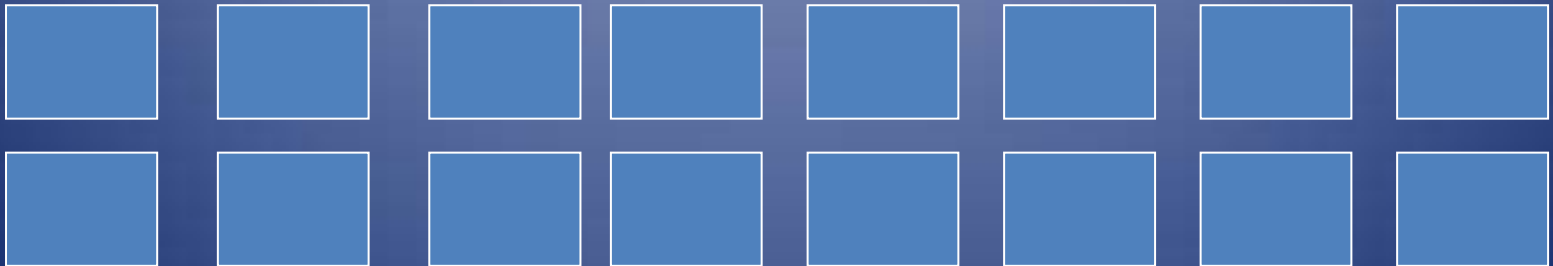


Matrix

8



16





# ¿Por que es difícil diferenciar los composites?



## Nano-híbridos y Nano-rellenos vs. Micro-híbridos

1. Poseen similares propiedades mecánicas.
  2. Estabilidad en almacenamiento en agua, con datos contradictorios.
  3. Similar susceptibilidad al envejecimiento.
  4. Bajas propiedades mecánicas en las formulaciones que incorporan pre-polímeros.
  5. Similares resultados en restauraciones C2 en periodos de 2 y 4 años.
1. Ilie N, Hickel R. ***Clin Oral Invest*** 2009. ADA Restor Mater 2010.
  2. Ilie N, Hickel R. ***Dent Mater*** 2009. Curtis AR, Palin WM, Fleming GJ, Shortall AC, Marquis PM. ***Dent Mater*** 2009.
  3. Hahnel S, Henrich A, Bürgers R, Handel G, Rosentritt M. ***Oper Dent*** 2010.
  4. Blackham JT, Vandewalle KS, Lien W. ***Oper Dent*** 2009.
  5. Ernst CP, Brandenbusch M, Meyer G, Canbek K, Gottschalk F, Willershausen B. ***Clin Oral Invest*** 2006. Kramer N, Reinelt C, Richter G, Petschelt A, Frankenberger R. ***Dent Mater*** 2009.

**Clasificación de las resinas  
compuestas en relación  
a la morfología de las  
partículas del relleno.**

# The effect of filler loading and morphology on the mechanical properties of contemporary composites

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 College of Dentistry, Kyungpook National University, Taegu, Korea; University of Texas Health Science Center at San Antonio, Texas; and Graduate School of Dentistry, Tohoku University, Sendai, Japan

## CLINICAL IMPLICATIONS

*In this in vitro study, filler morphology greatly influenced filler loading, which in turn affected the mechanical properties of the composites tested.*

**Statement of problem.** Little information exists regarding the filler morphology and loading of composites with respect to their effects on selected mechanical properties and fracture toughness.

**Purpose.** The objectives of this study were to: (1) classify commercial composites according to filler morphology, (2) evaluate the influence of filler morphology on filler loading, and (3) evaluate the effect of filler morphology and loading on the hardness, flexural strength, flexural modulus, and fracture toughness of contemporary composites.

**Material and methods.** Field emission scanning electron microscopy/energy dispersive spectroscopy was used to classify 3 specimens from each of 14 commercial composites into 4 groups according to filler morphology. The specimens (each 5 × 2.5 × 15 mm) were derived from the fractured remnants after the fracture toughness test. Filler weight content was determined by the standard ash method, and the volume content was calculated using the weight percentage and density of the filler and matrix components. Microhardness was measured with a Vickers hardness tester, and flexural strength and modulus were measured with a universal testing machine. A 3-point bending test (ASTM E-399) was used to determine the fracture toughness of each composite. Data were compared with analysis of variance followed by Duncan's multiple range test, both at the  $P < .05$  level of significance.

**Results.** The composites were classified into 4 categories according to filler morphology: prepolymerized, irregular-shaped, both prepolymerized and irregular-shaped, and round particles. Filler loading was influenced by filler morphology. Composites containing prepolymerized filler particles had the lowest filler content (25% to 51% of filler volume), whereas composites containing round particles had the highest filler content (59% to 60% of filler volume). The mechanical properties of the composites were related to their filler content. Composites with the highest filler by volume exhibited the highest flexural strength (120 to 129 MPa), flexural modulus (12 to 15 GPa), and hardness (101 to 117 VHN). Fracture toughness was also affected by filler volume, but maximum toughness was found at a threshold level of approximately 55% filler volume.

**Conclusion.** Within the limitations of this study, the commercial composites tested could be classified by their filler morphology. This property influenced filler loading. Both filler morphology and filler loading influenced flexural strength, flexural modulus, hardness, and fracture toughness. (J Prosthet Dent 2002;87:642-9.)

Table III. Mechanical properties of tested composites

Group	Product	Filler morphology	Flexural strength (MPa) <sup>a</sup>	Flexural modulus (GPa) <sup>a</sup>	VHN <sup>a</sup>	Fracture toughness K <sub>IC</sub> (MPa√m) <sup>a</sup>
1	Metafil CX	Pre-polymerized particles	75 ± 2 <sup>HI</sup>	3.4 ± 0.6 <sup>I</sup>	26 ± 1 <sup>I</sup>	0.63 ± 0.01 <sup>G</sup>
	Silux Plus		59 ± 2 <sup>GI</sup>	6.8 ± 0.4 <sup>GI</sup>	49 ± 3 <sup>HI</sup>	0.81 ± 0.07 <sup>F</sup>
	Heliomolar Radiopaque		78 ± 3 <sup>HI</sup>	5.5 ± 0.4 <sup>HI</sup>	36 ± 2 <sup>I</sup>	0.84 ± 0.02 <sup>E</sup>
	Palfique Estelite		74 ± 2 <sup>HI</sup>	6.7 ± 0.5 <sup>GI</sup>	57 ± 3 <sup>GI</sup>	0.85 ± 0.01 <sup>E</sup>
2	Aelitefil	Irregular-shaped particles	123 ± 2 <sup>B</sup>	11.6 ± 1.2 <sup>BC</sup>	89 ± 5 <sup>C</sup>	0.98 ± 0.03 <sup>C</sup>
	Charisma		113 ± 3 <sup>DEF</sup>	10.2 ± 0.9 <sup>DE</sup>	79 ± 4 <sup>DE</sup>	0.75 ± 0.02 <sup>F</sup>
	Herculite XR		125 ± 3 <sup>AB</sup>	10.4 ± 0.9 <sup>DE</sup>	77 ± 4 <sup>F</sup>	0.85 ± 0.01 <sup>F</sup>
	Hipolite		109 ± 3 <sup>F</sup>	11.4 ± 1.2 <sup>BCD</sup>	56 ± 2 <sup>G</sup>	1.14 ± 0.07 <sup>A</sup>
	TPH		116 ± 4 <sup>DC</sup>	9.6 ± 0.8 <sup>F</sup>	60 ± 2 <sup>G</sup>	1.04 ± 0.04 <sup>B</sup>
Veridontil	114 ± 3 <sup>DE</sup>	11.6 ± 0.9 <sup>BC</sup>	64 ± 3 <sup>F</sup>	1.08 ± 0.03 <sup>B</sup>		
3	Photoclearfil	Pre-polymerized + irregular-shaped particles	80 ± 2 <sup>C</sup>	8.4 ± 1.0 <sup>F</sup>	63 ± 2 <sup>F</sup>	0.91 ± 0.07 <sup>D</sup>
	Pertac-Hybrid		109 ± 3 <sup>EF</sup>	11.0 ± 0.9 <sup>CD</sup>	81 ± 3 <sup>D</sup>	1.06 ± 0.08 <sup>B</sup>
4	Z-100	Round particles	129 ± 5 <sup>A</sup>	15.0 ± 1.3 <sup>A</sup>	117 ± 5 <sup>A</sup>	0.97 ± 0.04 <sup>C</sup>
	Palfique Toughwell		120 ± 3 <sup>BC</sup>	12.3 ± 1.3 <sup>B</sup>	101 ± 4 <sup>B</sup>	0.96 ± 0.03 <sup>D</sup>

Within each column, values marked with the same capital letter were not significantly different (Duncan's multiple range test,  $P < 0.5$ ).  
<sup>a</sup>Significantly different (1-way ANOVA,  $P < 0.5$ ).

## CONCLUSIONS

Within the limitations of this study, composites could be classified by their filler morphology. Composites that contained prepolymerized filler particles had the lowest filler loading and therefore the lowest flexural properties and hardness. Composites that contained round filler particles had the highest filler loading, resulting in the highest flexural properties and hardness. Composites that contained either irregular-shaped or a mixture of prepolymerized and irregular-shaped filler particles had intermediate filler loading, flexural properties, and hardness. High filler loading was not associated with high fracture toughness.

# Experimentación

5 muestras por cada composite.

**Group and Composite**

**G1 Heliomolar®**

**G2 Filtek™ Z350**

**G3 Tetric® N Ceram**

**G4 Point 4™**

**G5 Premisa™**

**G6 Esthet.X® HD**

**G7 ice**

**G8 Vit-L-escence®**

**G9 Grandio®**

**G10 TPH®3**

**G11 Amelogen® Plus**

**G12 Brilliant Enamel**

**G13 Filtek™ Z100**

**G14 ROK**

**G15 Solare**

**G16 KALORE™**

**G17 Filtek™ Z250**

**G18 Filtek™ P60**



# Metodología.

- Para observar el relleno se utilizo el método del lavado de la matriz con acetona de pureza analítica, el sobrante no removido se polimerizo, se deseco y orifico para ser observado en microscopio electrónico de barrido (**SEM**) ZEISS Supra 40 del CMA de la Facultad de Ciencias Exactas de la Universidad de Buenos Aires

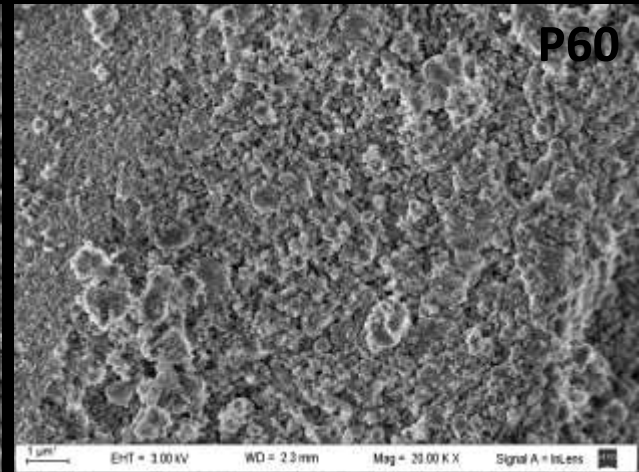
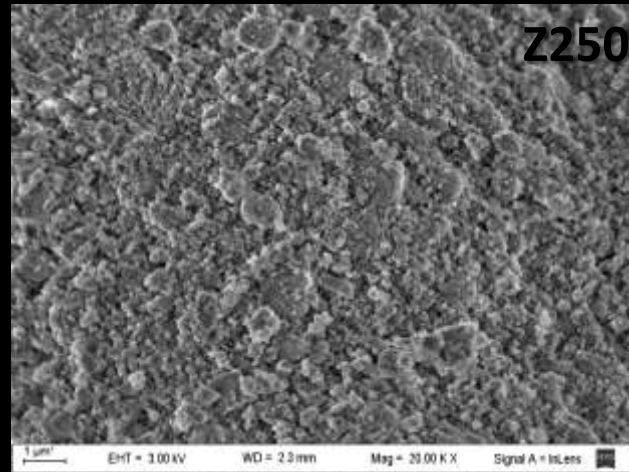
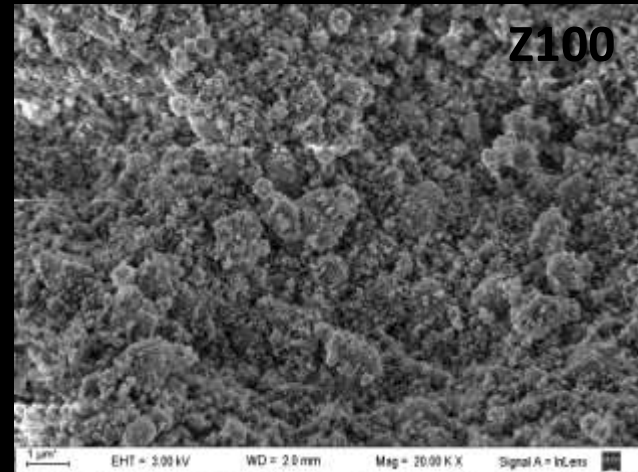


# Resultado= 5 Formas:

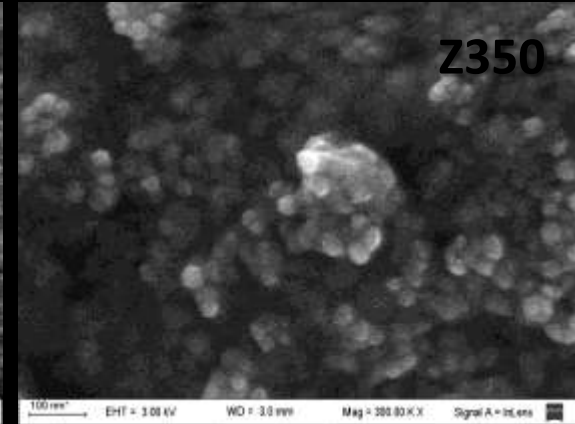
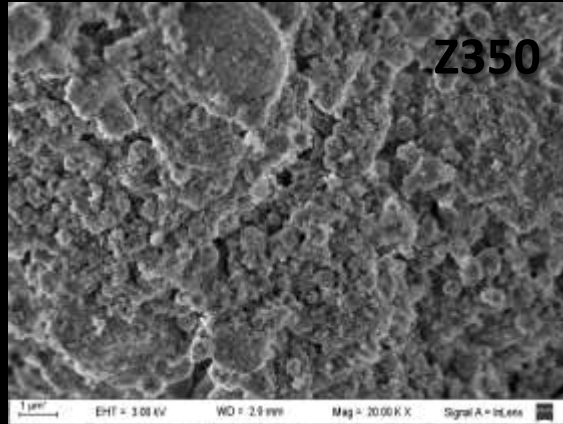
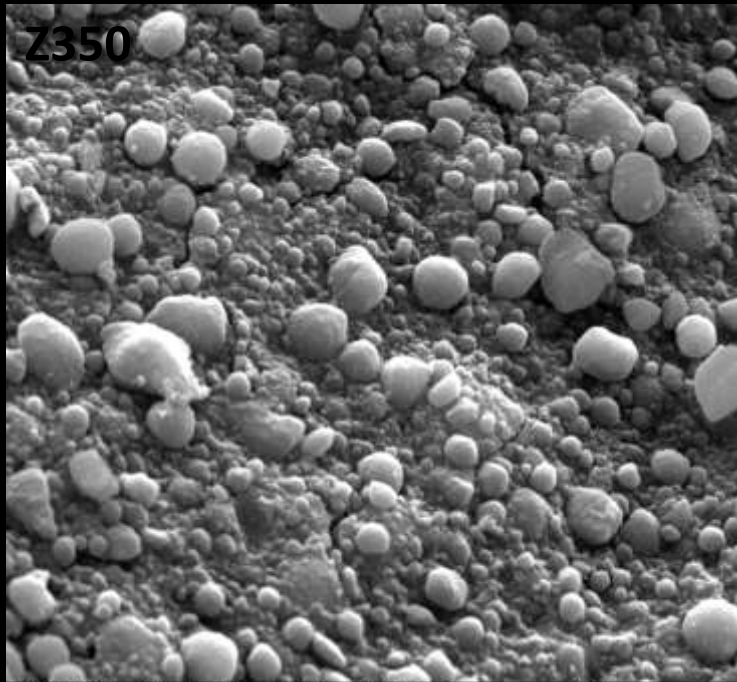
- Esféricas
- Conglomerados esféricos
- Irregulares
- Pre – Polímeros
- Irregulares + Pre – polímeros



# Relleno esférico.

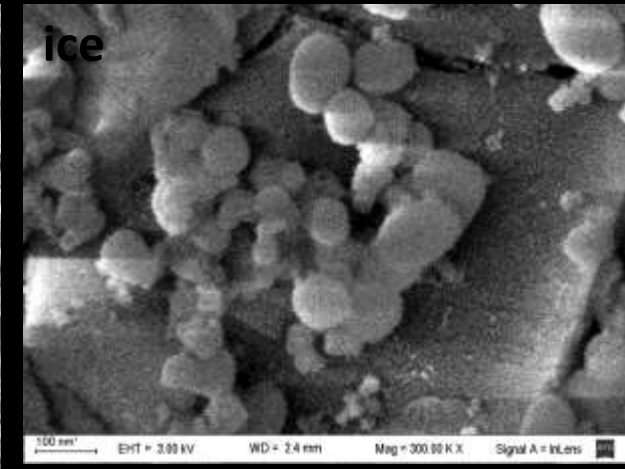
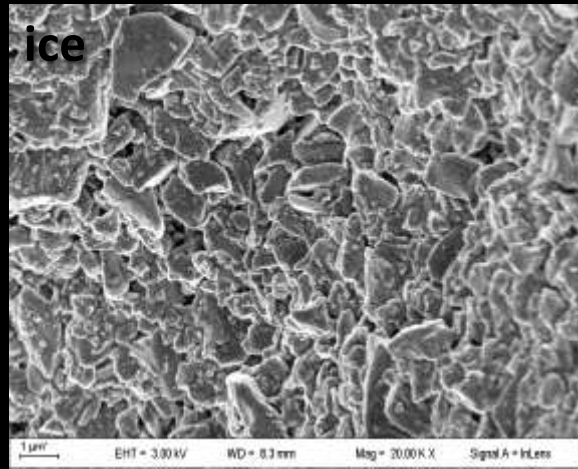
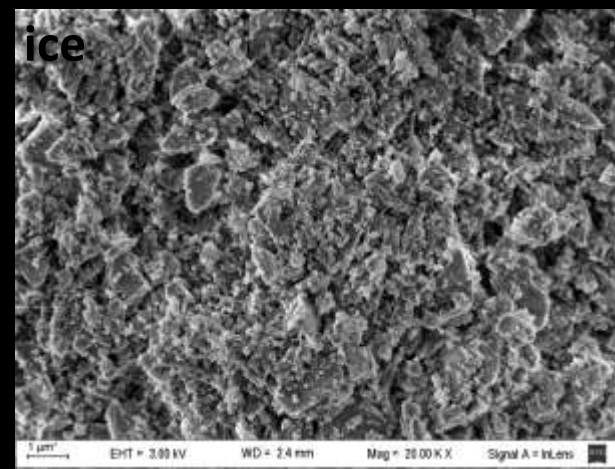
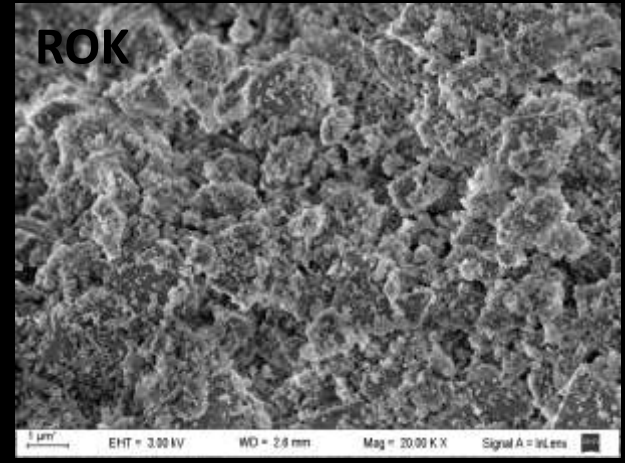
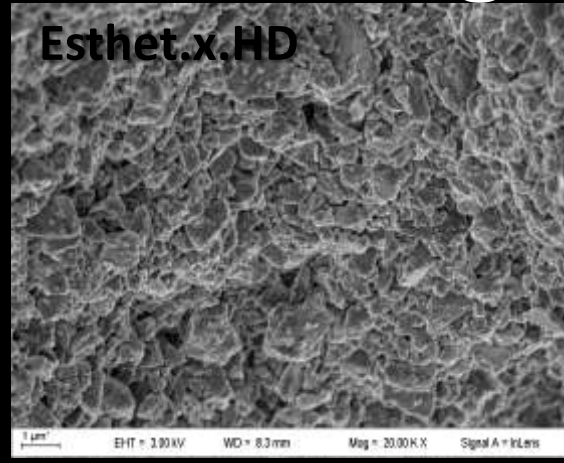
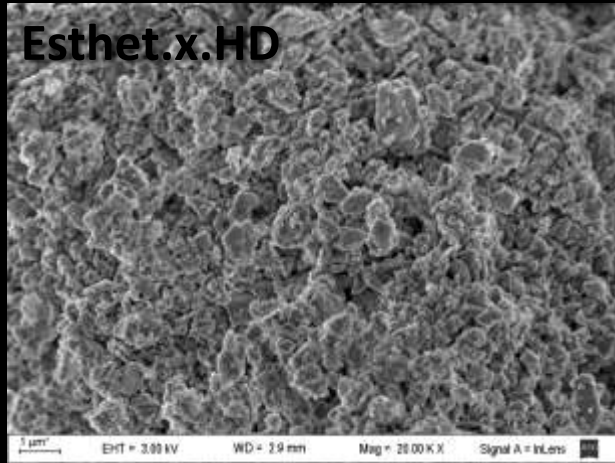


# Relleno de conglomerados esféricos

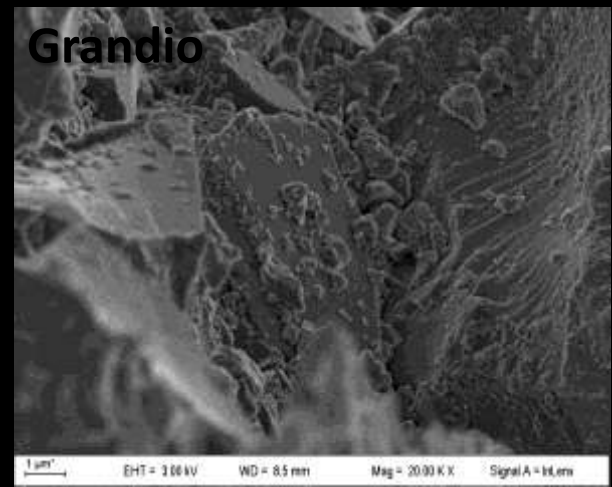
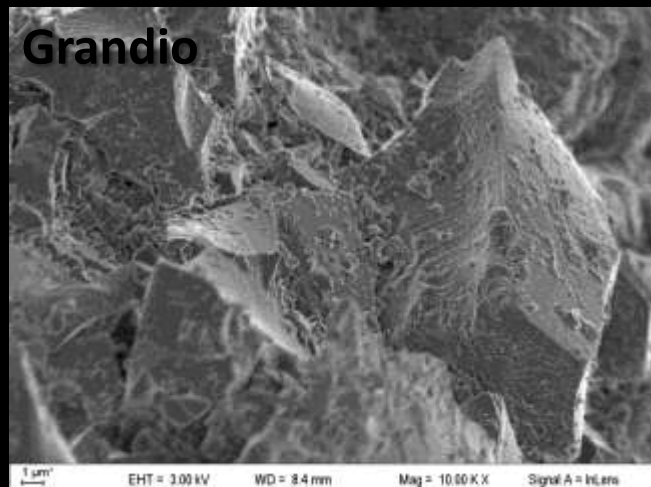
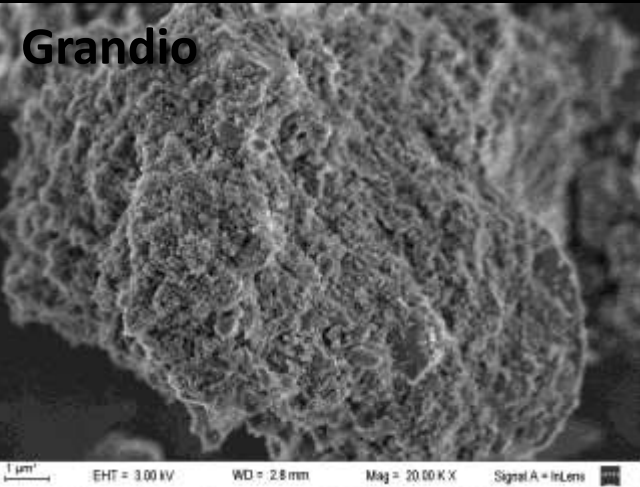
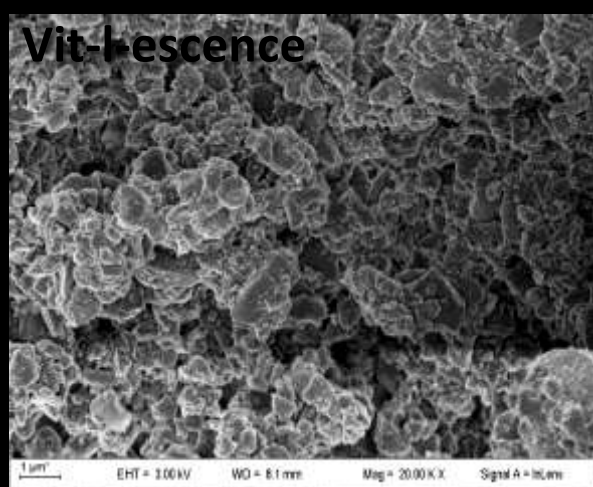
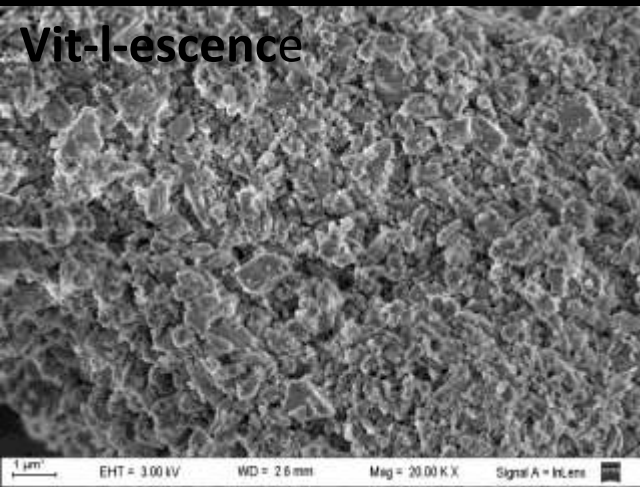


6/25/2009	HV	mag	WD	mode	spot	10 µm
3:59:37 PM	25.00 kV	10 000 x	10.6 mm	SE	3.5	CNEAMAT - GME

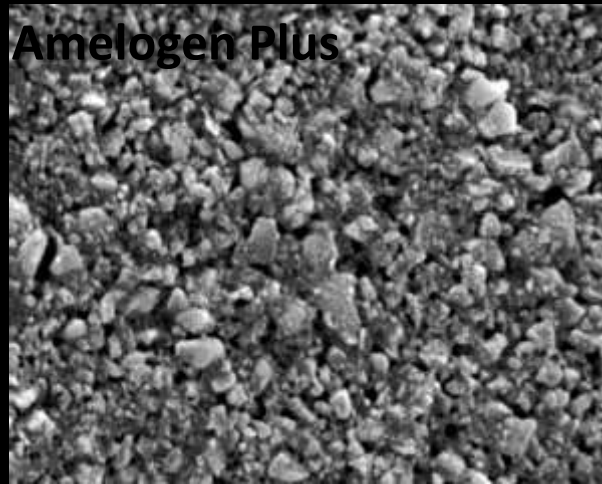
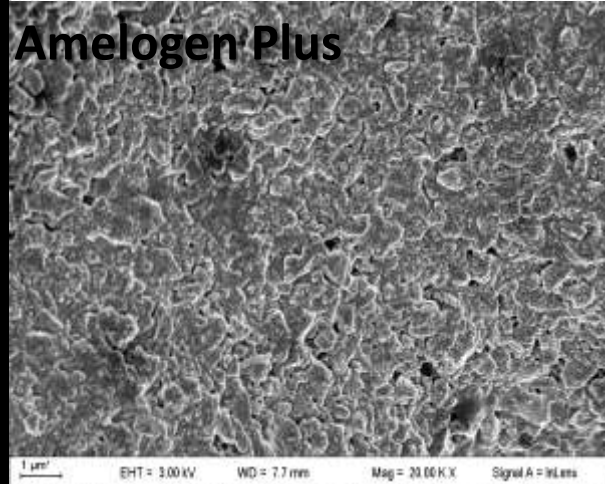
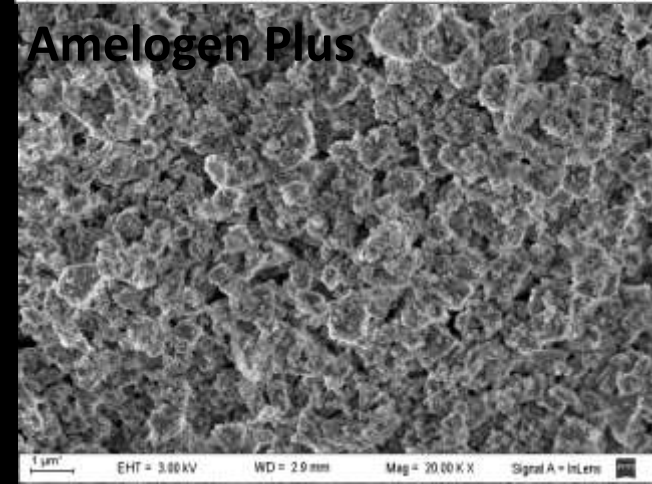
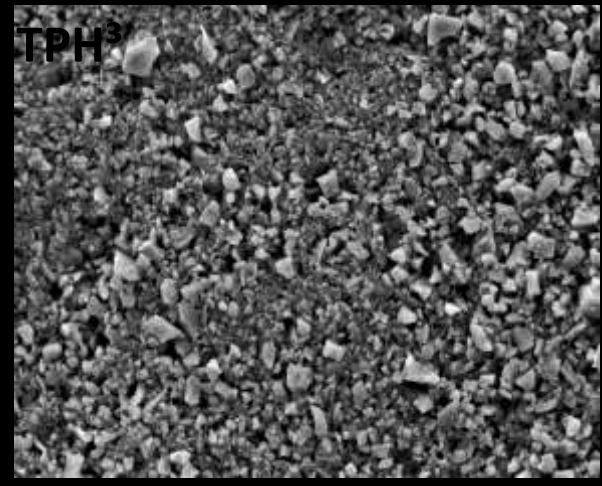
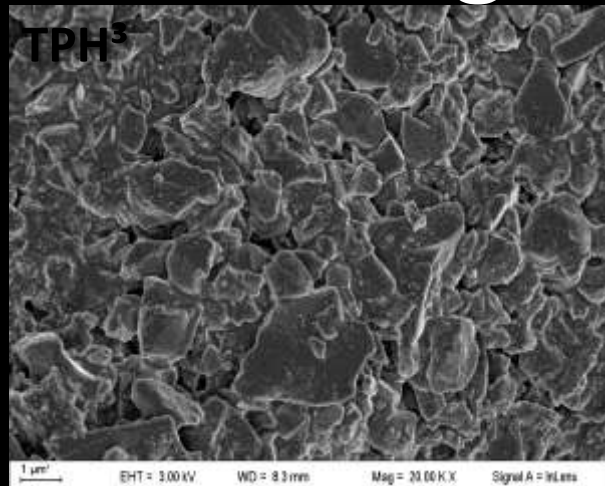
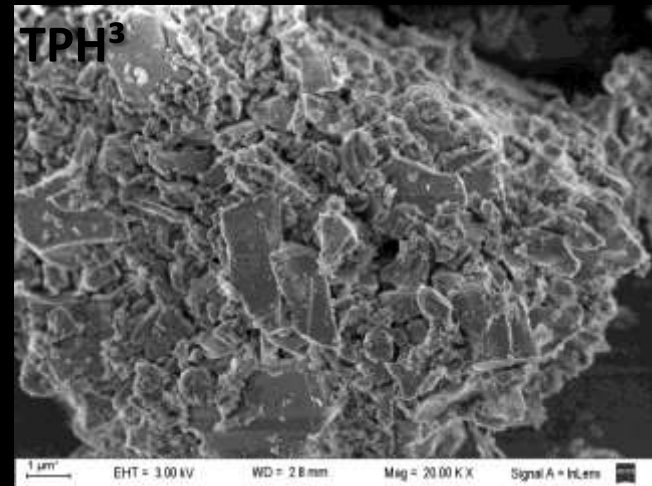
# Relleno Irregular



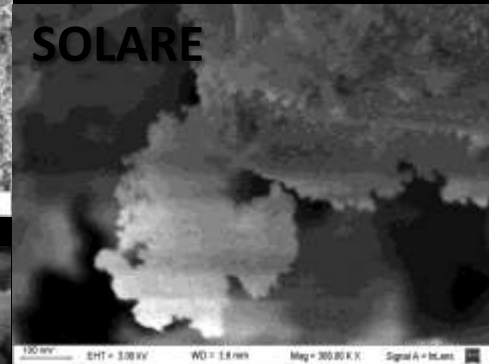
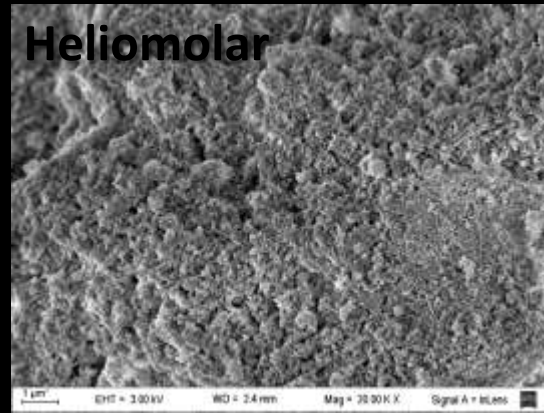
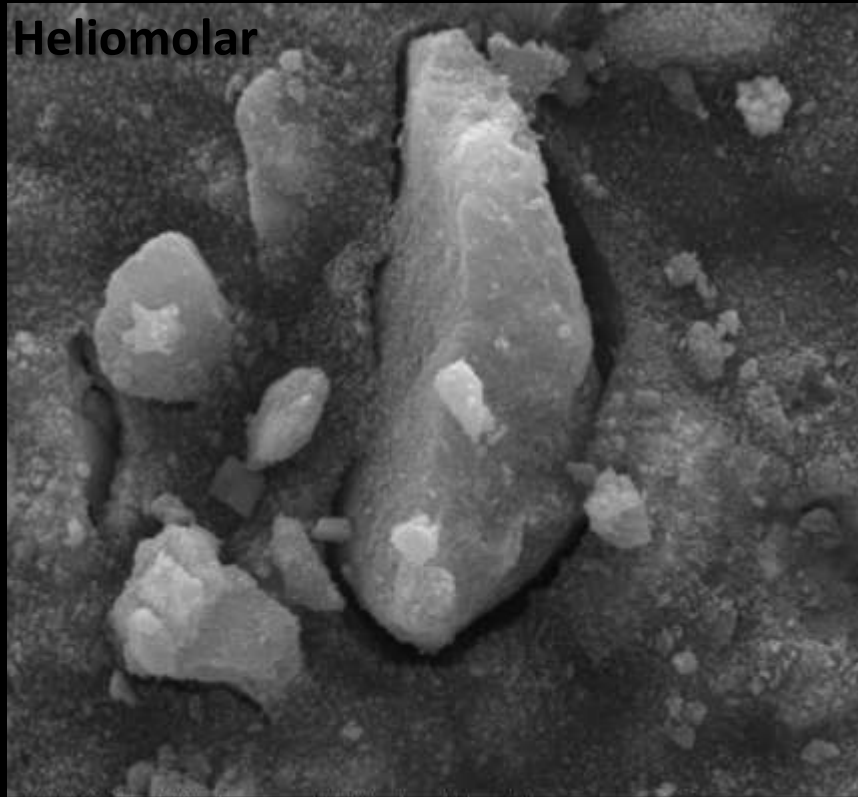
Relleño Irregular



# Relleno Irregular

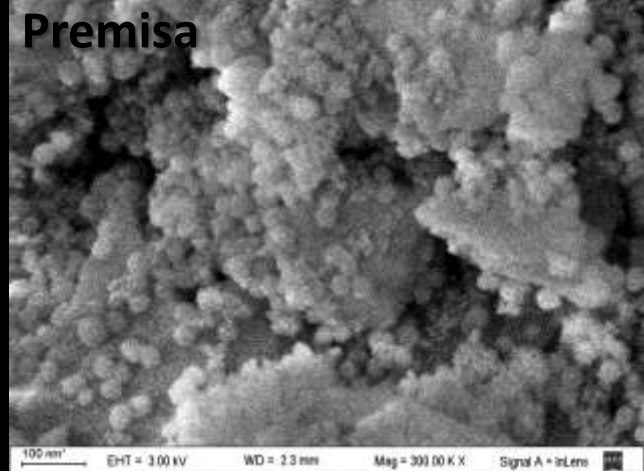
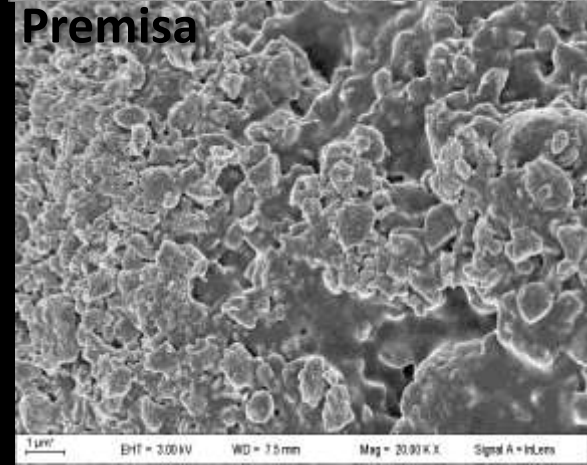
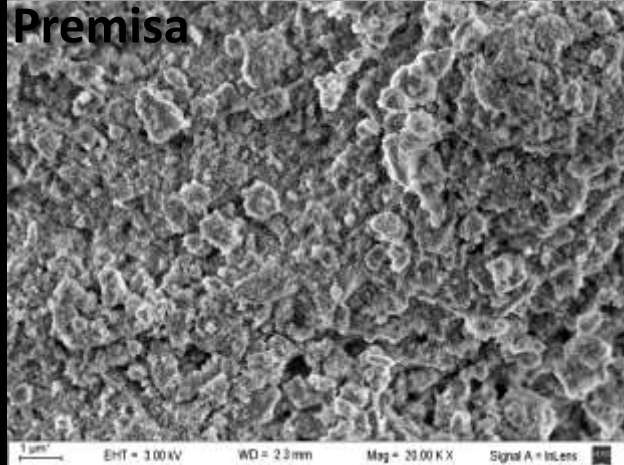
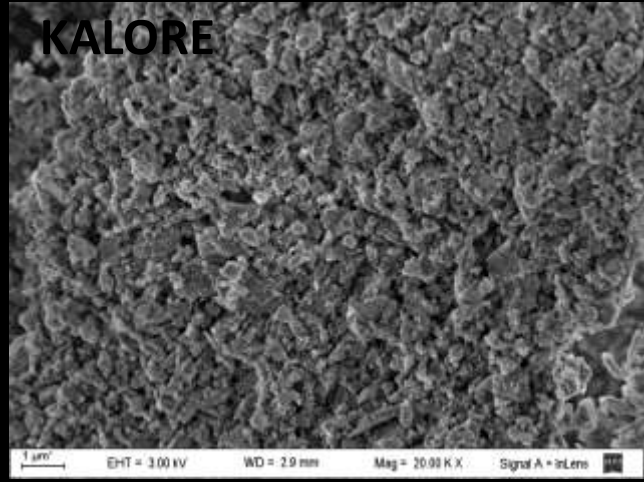
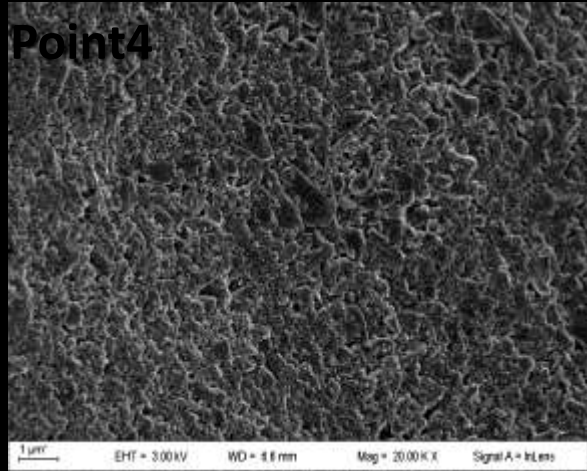
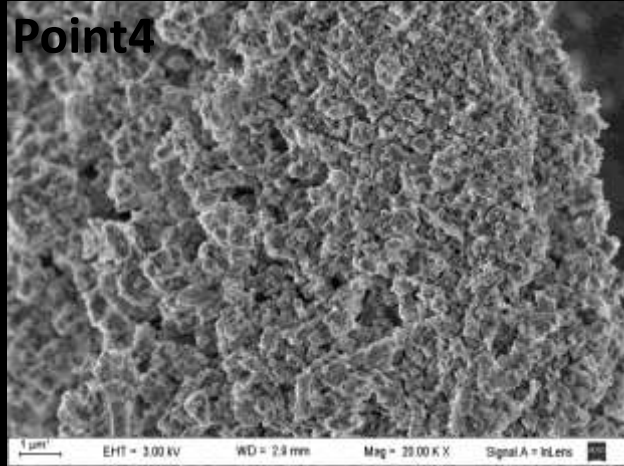


# Releno Pre – Polimerizado

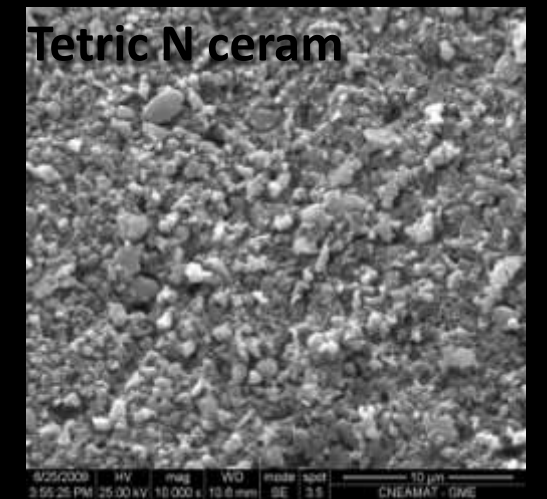
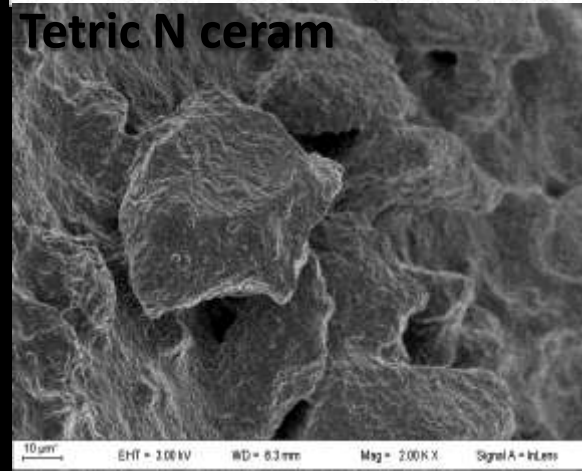
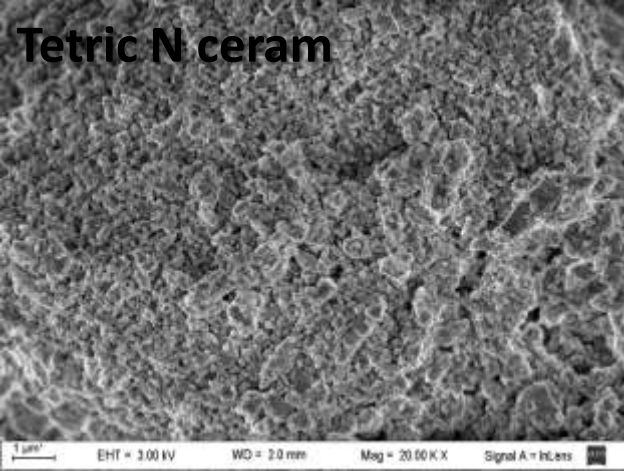
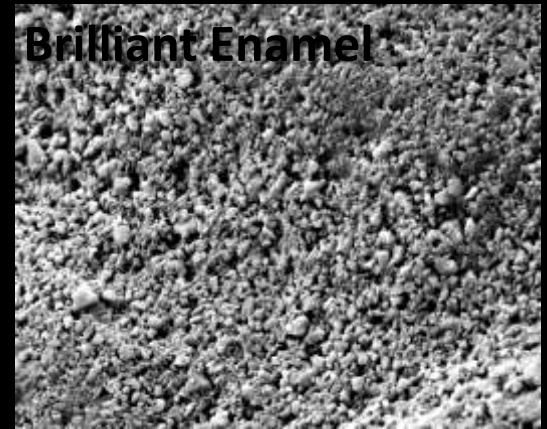
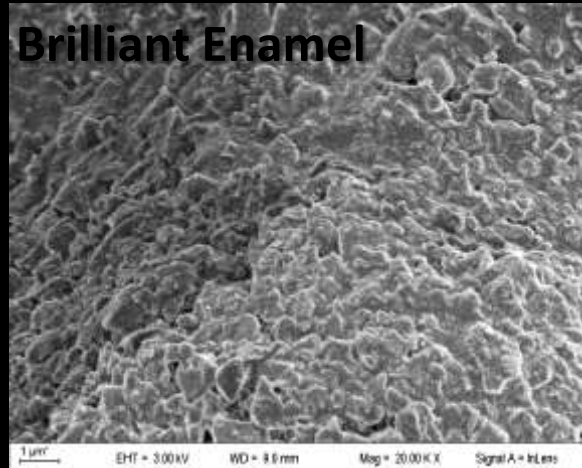
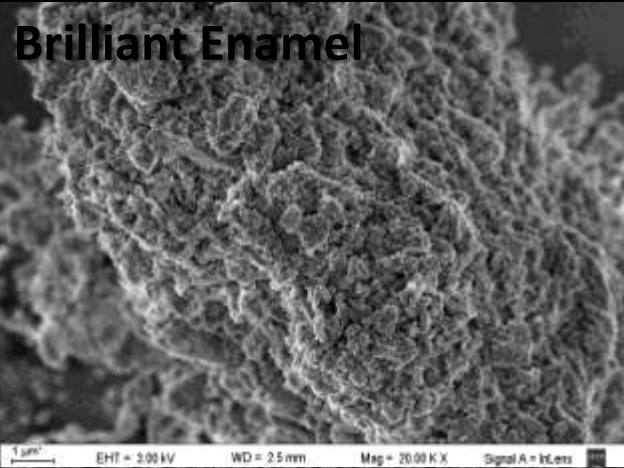


6/25/2009 HV mag WD mode spot  
3:46:54 PM 25.00 kV 10 000 x 8.9 mm SE 3.5  
10 µm  
CNEAMAT - GME

# Irregular +Pre - polímero



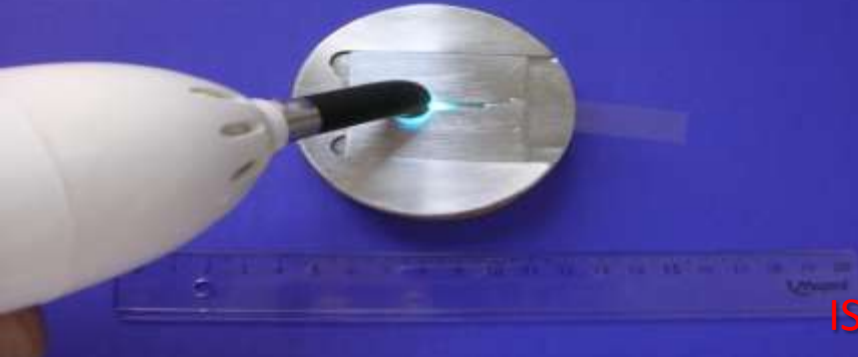
# Irregular +Pre - polímero



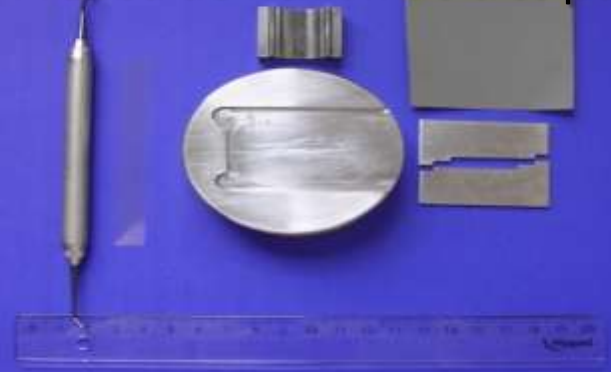


# Ensayo para determinar las propiedades flexurales

Fabricación de probetas.



Instrumental y molde de acero inoxidable.  
Prueba de flexión de tres puntos.

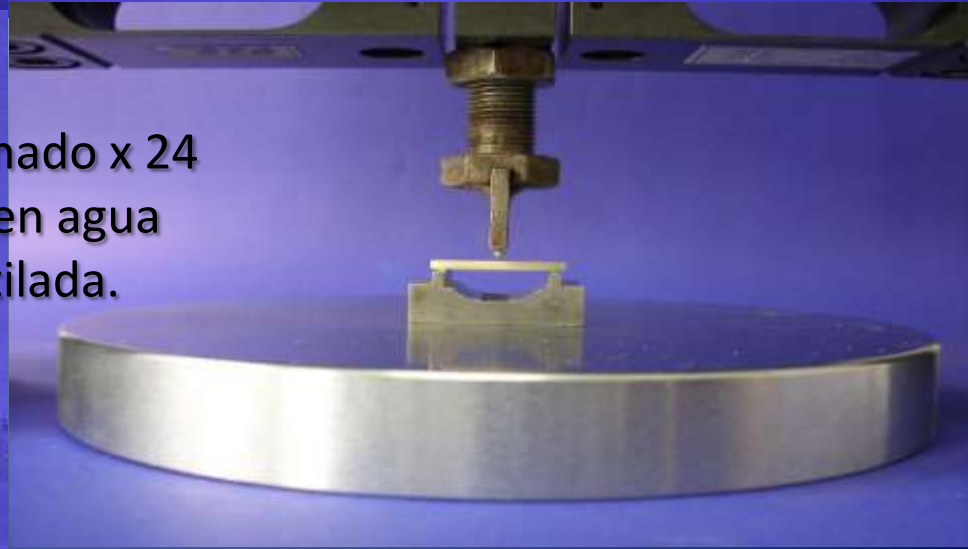


ISO 4049/2000

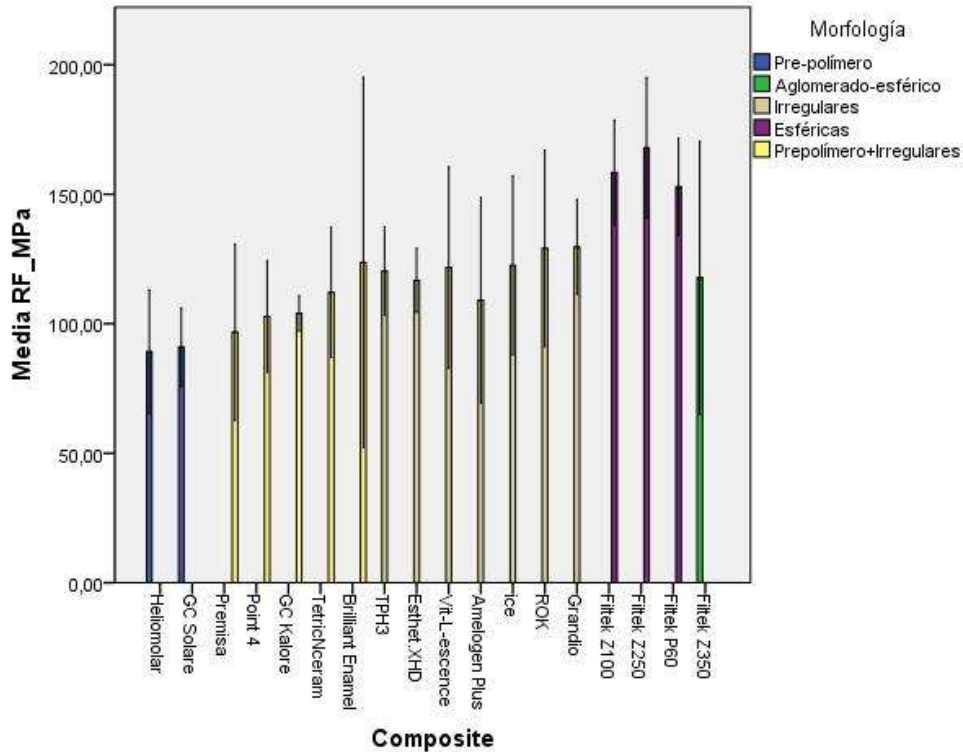
Eliminación de excesos.



Almacenado x 24  
Horas en agua  
Destilada.



# Resistencia Flexural



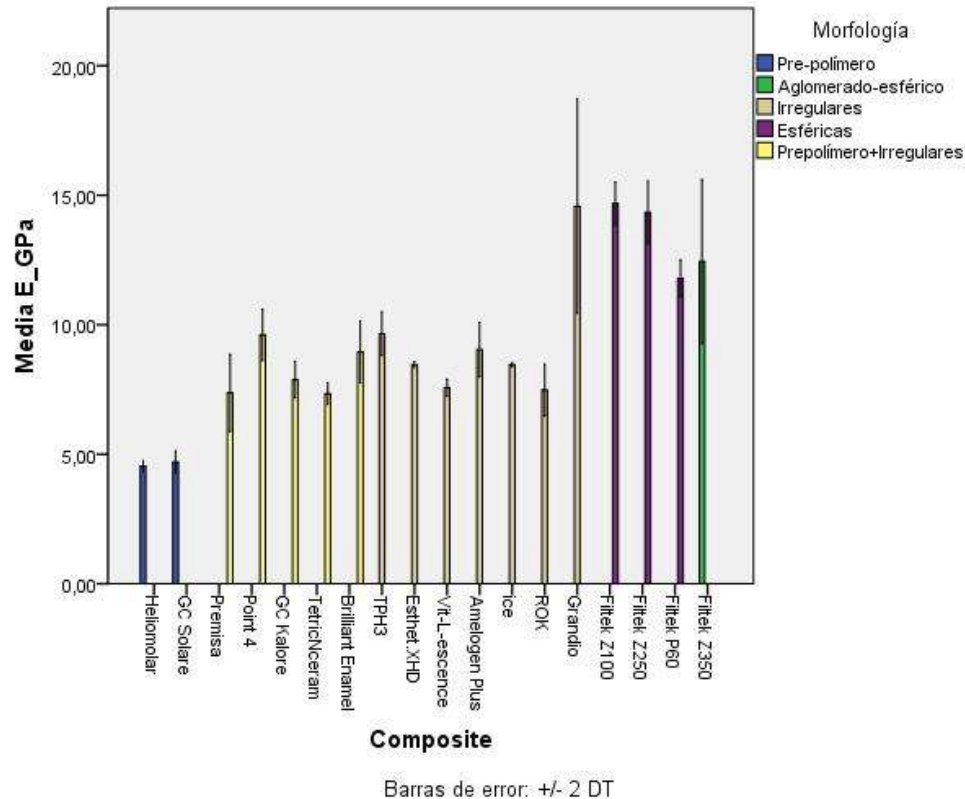
Tukey HSD<sup>a,b</sup>

Morfología	N	Subset		
		1	2	3
Pre-polímero	10	90,0994		
Prepolímero+Irregulares	25	107,8471	107,8471	
Aglomerado-esférico	5		117,7686	
Irregulares	35		121,3109	
Esféricas	15			159,7403
Sig.		,086	,301	1,000

Means for groups in homogeneous subsets are displayed.  
Based on observed means.  
The error term is Mean Square(Error) = 274,280.

a. Uses Harmonic Mean Sample Size = 11,488.  
b. Alpha = ,05.

# Módulo Flexural



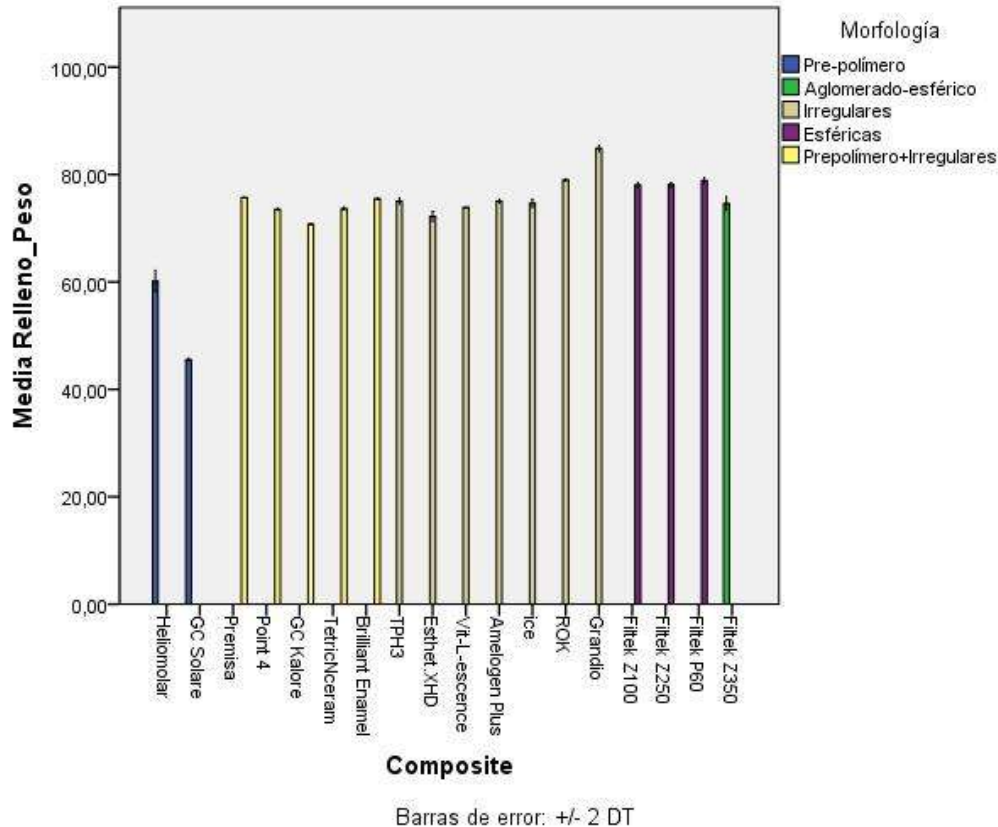
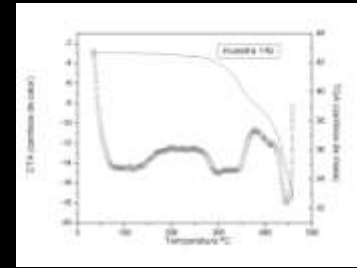
Tukey HSD<sup>a,b</sup>

Morfología	N	Subset		
		1	2	3
Pre-polímero	10	4,6217		
Prepolímero+Irregulares	25		8,2270	
Irregulares	35		9,3170	
Aglomerado-esférico	5			12,4426
Esféricas	15			13,5973
Sig.		1,000	,084	,058

Means for groups in homogeneous subsets are displayed.  
Based on observed means.  
The error term is Mean Square(Error) = 1,025.

a. Uses Harmonic Mean Sample Size = 11,488.  
b. Alpha = ,05.

# Relleno en Peso



## Relleno\_Peso

Tukey HSD<sup>a,b</sup>

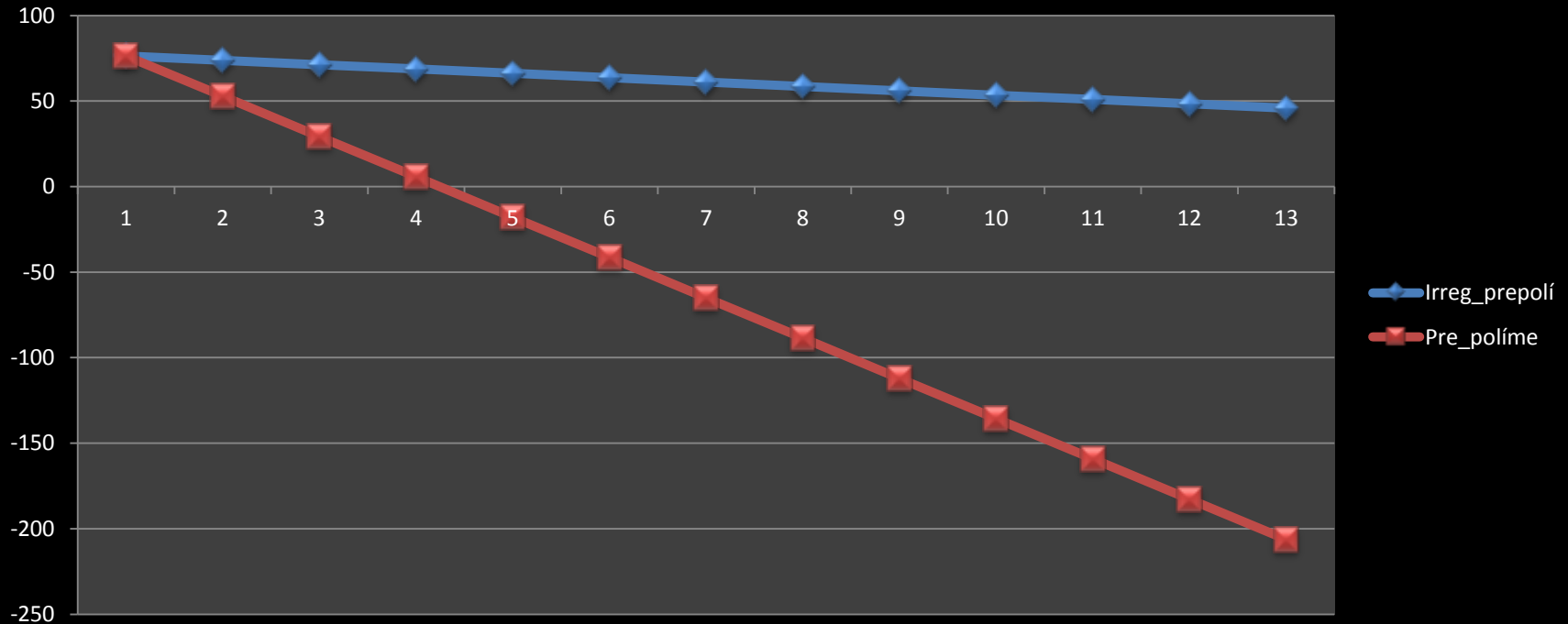
Morfología	N	Subset		
		1	2	3
Pre-polímero	10	52,8204		
Prepolímero+Irregulares	25		73,8356	
Aglomerado-esférico	5		74,6014	
Irregulares	35		76,3816	76,3816
Esféricas	15			78,3303
Sig.		1,000	,234	,501

Means for groups in homogeneous subsets are displayed.  
Based on observed means.  
The error term is Mean Square(Error) = 8,509.

a. Uses Harmonic Mean Sample Size = 11,488.  
b. Alpha = ,05.

# Regresión Lineal Cantidad de relleno/morfología

R<sup>2</sup> 0,808



# Implicaciones clínicas de las propiedades mecánicas:

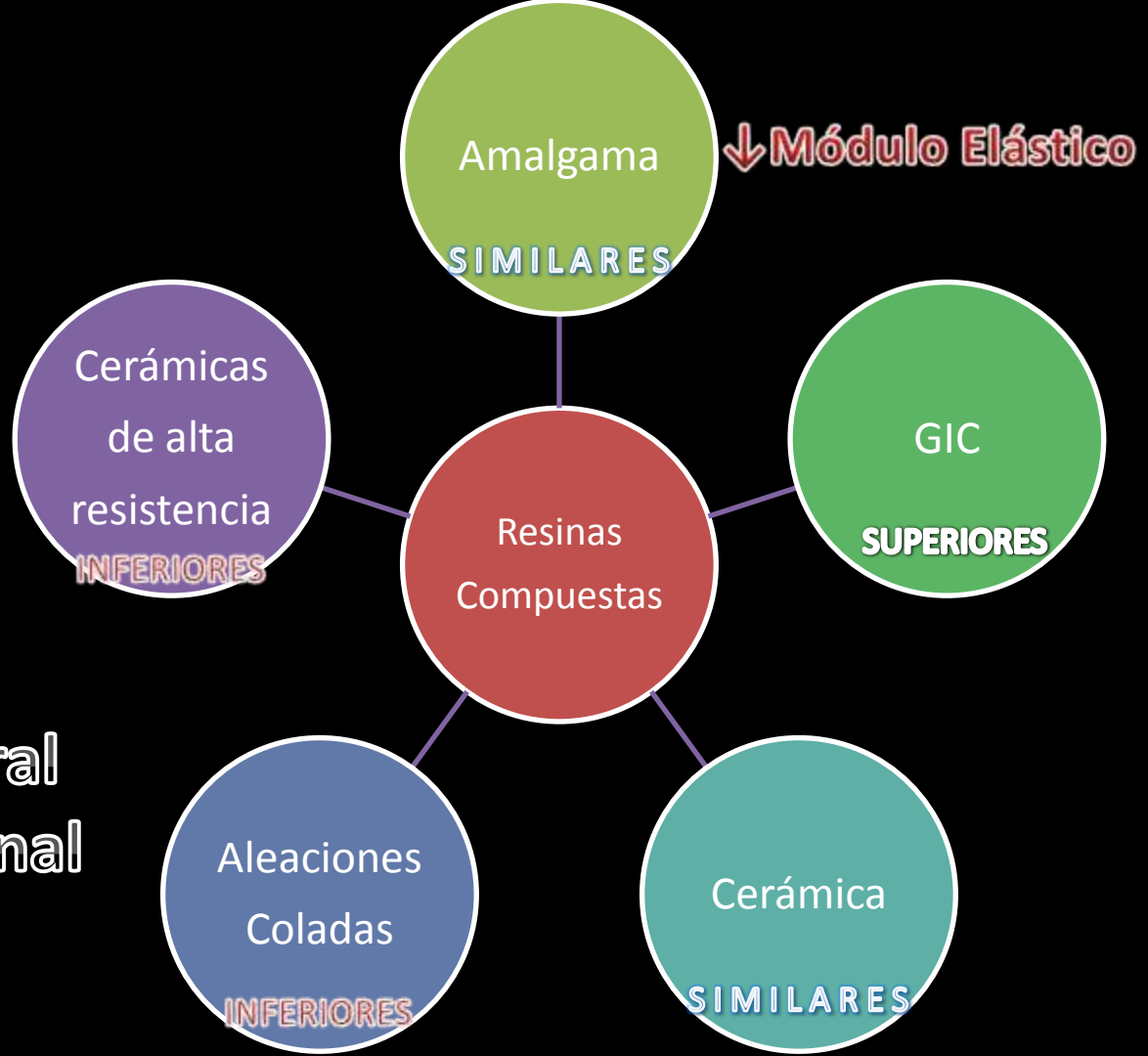
- Las formulaciones actuales poseen adecuadas propiedades para el uso en todas las áreas de la boca, con excepción de las situaciones de alto estrés.
- El desgaste es considerado un problema menor, sin embargo hay que prestar atención en las restauraciones de gran tamaño, a las reconstrucciones por cuadrante y cuando se usa como reemplazo de cúspides.

Kramer N, Reinelt C, Richter G, Petschelt A, Frankenberger R. Nanohybrid vs. fine particle composite in class II cavities: clinical results and margin analysis after four years. *Dent Mater* 2009;25:750-9.

41. Ferracane JL. *Is the wear of dental composites still a clinical concern? Is there still a need for in vitro wear simulating devices?* *Dent Mater* 2006;22:689-92.

“En general las propiedades mecánicas de las resinas compuestas se relacionan con la cantidad de relleno posible, entonces a mayor cantidad, más resistentes, rígidos y tenaces”.

Resistencia Flexural  
Resistencia Tensional  
Tenacidad





# Relación Resistencia-Estética

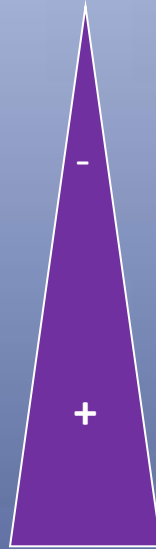
Resistencia

- híbrida
- nano-híbrida
- micro-híbrida
- nano-relleno
- micro-relleno



Estética

- esféricas
- irregulares
- irregulares + Pre – polímeros
- aglomerados esféricos
- Pre – polímeros



# Caso Clínico

**Paciente femenino de 42 años con restauraciones en mal estado en los dos centrales superiores.**









## Con respecto al tipo de aislamiento:

Review

### Clinical performance of cervical restorations— A meta-analysis

Siegward D. Heintze<sup>a,\*</sup>, Christiane Ruffieux<sup>b</sup>, Valentin Rousson<sup>b</sup>

DENTAL MATERIALS 26 (2010) 993–1000

[8] Kubo S, Kawasaki K, Yokota H, Hayashi Y. Five-year clinical evaluation of two adhesive systems in non-carious cervical lesions. J Dent 2006;34:97–105.

[19] van Dijken JWV. Clinical evaluation of three adhesive systems in class V non-carious lesions. Dent Mater 2000;16:285–91.













# Finalmente

La utilización de una clasificación específica se origina del propósito de ubicar a todos y cada uno de sus tipos en una sola categoría, para que no se convierta en una clasificación ambigua ó carente de utilidad, esto nos debe permitir tomar decisiones para su uso en la práctica diaria, en búsqueda del mejor desempeño, pues “las perdidas tempranas ó inferiores a 5 años se asocian a fallas en la técnica y a la incorrecta selección del material”.

# Expectativas para el futuro.

- Matrices que no contraigan.
- Material inteligente, que dependiendo del pH libera más ó menos fluoruro.
- Resinas compuestas restauradoras de uso universal auto-adhesivas.
- Propiedades antibacterianas.
- Mejoren la capacidad de sellado dentina.



Gracias por su atención



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<http://webdelprofesor.ula.ve/odontologia/robertramirez/>