

Composite research at Microelectronics Research Unit

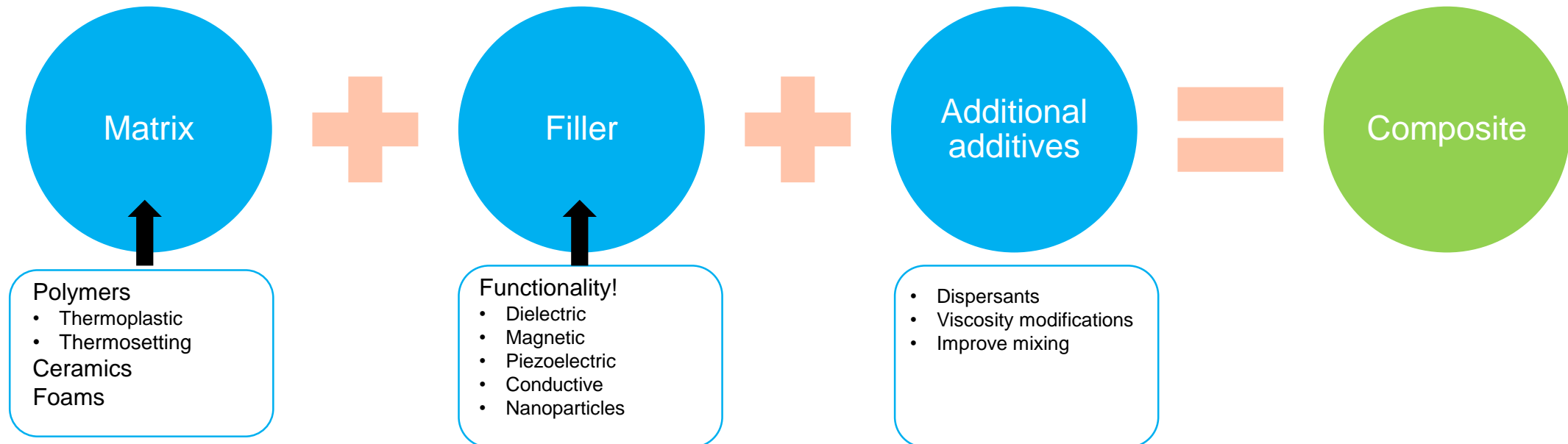


Microelectronics
RESEARCH UNIT



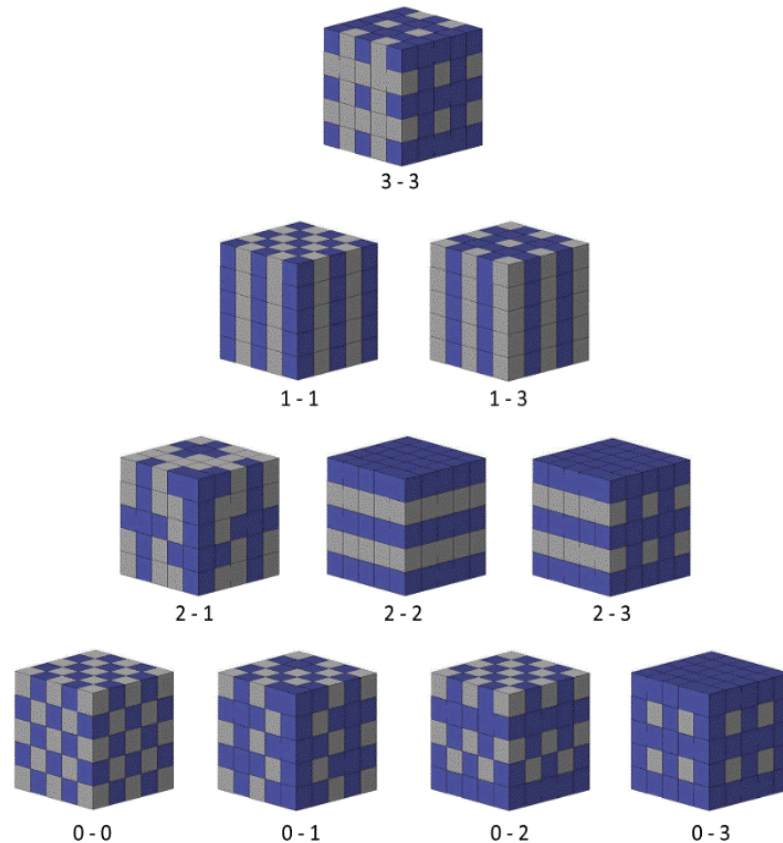
Basics of composites

- A composite is a material that is made from two or more constituent materials to produce a material with characteristics different from the individual components.
- The individual materials usually differ significantly by their physical or chemical properties and components remain separate within the final product.





Basics of composites



- In Microelectronics research unit the research of composites include:
- polymer-based composites with dielectric or magnetic properties mainly on high frequency applications and with ferro/piezoelectric properties for sensors and actuator
- Inks with dielectric, magnetic or ferro/piezoelectric properties for printed electronics application
- Foams with dielectric, piezoelectric or conductive properties for various sensors or antennas and magnetic properties for other purposes, e.g. oil/water filters



Polymer-ceramic composites



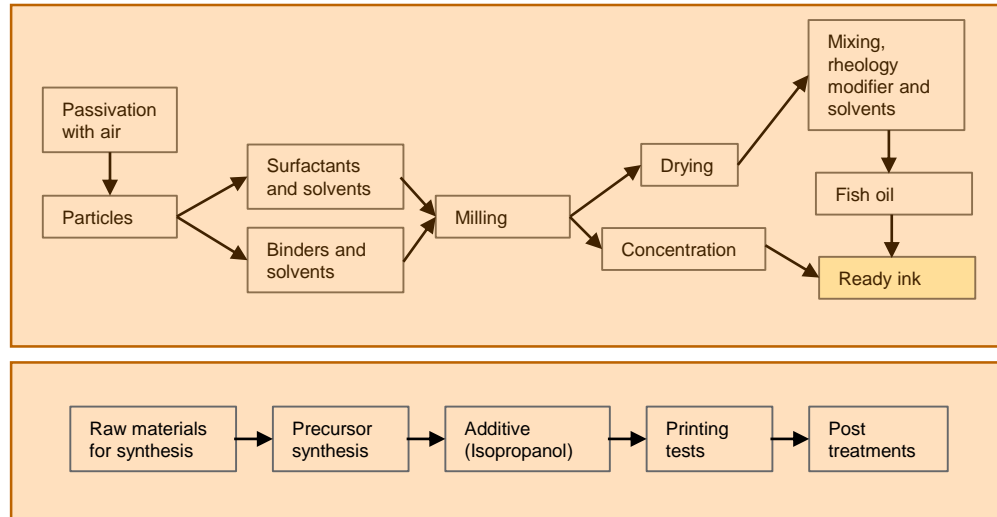
- Matrix material usually thermoplastic (PP, COC, LCP, PE...)
- Functional filler dielectric, conducting, magnetic, semiconducting or ferroelectric particles with various sizes and shapes.
- Materials mixed with mixing extruder and samples made with injection moulding system. Structures can be formed with additive manufacturing system (3D printing)
- Application areas: Antenna substrates, sensors and actuators





Composite inks

Possible routes for ink formation

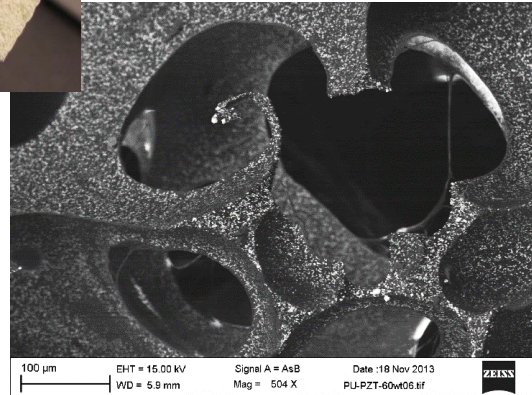


- Inks based on dry inorganic powders with polymer matrix
- Printing can be done with screen-, gravure- and ink-jet printing
- Substrates: paper, polymer, ceramic, metal
- Enabling magnetic, piezoelectric and memory resistive (memristive) function for printed electronics applications





Composite foams



- Many possibilities for matrix material - PU common
- Fillers used in various shapes (e.g. spheres) and sizes (micro or nano)
- Fabrication possibilities, e.g.:
 - a. room temperature or "high" temperature (thermoplastic processing) **mixing** of components
 - b. **coating** foam with additives
 - c. using matrix material as **template**
- **Applications:**
 - soft/flexible strain and pressure sensors, in antennas



Previous Composite related projects

– **TEKES funded**

- Composites of Nanomaterials and Polymers (CoNaPo)
- Composites of Nanomaterials and Polymers - Extension (CoNaPo-EXT)
- Magnetic nanoparticles for ink applications (Magia)
- Printed activity and movement sensors (PAMS)
- Hybrid Materials Programme (FIMECC Hybrids)

– **ERANET**

- Novel inorganic inks for hybrid printed electronic demonstrators (Innoinks)



Related Doctoral dissertations

Mikko Nelo (2015): Inks based on inorganic nanomaterials for printed electronics applications

Merja Teirikangas (2011): Advanced 0-3 ceramic-polymer composites for high frequency application

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