

## Nanocomposites and nanomaterials

**Subnano-sized “particles” – invisible but effective:  
polycyanurate/silica subnano- and nanocomposites obtained by sol-gel  
synthesis, their nanostructure and properties**

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A series of polycyanurate (PCN)-based composites containing 0.01-10 wt. % silica, introduced by sol-gel method, was synthesized using dicyanate ester of bisphenol E (DCBE), tetraethoxysilane (TEOS) and  $\gamma$ -aminopropyltrimethoxysilane (APTMS), and their nanostructure and properties were characterized by means of STEM/EDXS, Far-IR spectroscopy, DMA, DSC and laser-interferometric CRS methods. It was revealed that the most substantial positive impact on PCN dynamics, thermal and mechanical properties is attained at ultra-low silica contents, e.g., at 0.1 wt. % silica where  $T_g$  and modulus increase, respectively, by 50<sup>0</sup> and 60%. In this case, silica nanoclusters are absent in the composite, and only chemically incorporated silica junctions of subnanometric size in the densely cross-linked PCN network could be implied. These composites can be designated as “*polymer subnanocomposites*”. Contrarily, formation of silica nanoclusters and especially their aggregates of hundreds nanometers in size at silica contents of 2-10 wt. % led to the distinct negative impact on the matrix properties.