Nanocomposites and nanomaterials

Nanoindentation study of light-curing volumetric shrinkage in dimethacrylate-based dental nanocomposites

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The nanoindentation technique exploring CSM instrument equipped with a Berkovitch-type tip was employed to study photoinduced volumetric shrinkage in acrylic-type dental nanocomposites Dipol EA3, the nanohardness and Young's modulus being controlled at a sum-micron indentation depth in accordance to [1]. The tested samples of this nanocomposite based on UDMA-BisGMA (urethane dimethacrylates and bisphenol A-diglycidyl dimethacrylate) matrix modified with nanofiller (more than 70% of highly dispersive silica glass with particles sizes ranged within 0.001-1 μm domain) were prepared by one-layer covering in a disc-type form having near 2 mm in thickness. They were affected to photoexposure using standard UV source by separate steps lasting from 5 to 60 s.

The overall polymerization in the studied dental nanocomposites occurs to be fully saturated after 30-35 s of photoexposure, thus reaching a level of 0.330 GPa for nanohardness and 7.20 GPa for Young's modulus. The observed growing kinetics in nanohardness and Young's modulus is well fitted by single exponential dependence with time constant of 15-16 s. These parameters are compared with ones character for light-curing volumetric shrinkage in these nanocomposites detected through positron annihilation lifetime spectroscopy [2].

1. *Oliver W.C., Pharr G.M.,* An improved technique for determining hardness and elastic modulus using load and displacement sensing indentation experiments // J. Mater. Res.-1992.-**7**, N 6.-P. 1564-15683.
2. *Boyko O., Shpotyuk Ya., Filipecki J.* Positron annihilation lifetime study of extended defects in semiconductor glasses and polymers // Phys. Stat. Sol. C.-2013.-**10**, N 1.-P. 121-124.