Synthesis and characterisation of cobalt blue/ polydimethylsiloxane composite layers

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Polydimethylsiloxane (PDMS) is one of the most frequently used material for dielectric elastomer actuators due to its good elasticity, reliability, and fast response speed.

To enhance the actuation efficiency different types of inorganic particles have been added (titanates, metals, organo-clays, carbo materials). Since cobalt blue (CB) is a high-grade eco-friendly intense blue pigment with high refractive index and excellent thermal and chemical stability, we considered to be attractive for obtaining new cobalt blue/polydimethylsiloxane composite layers with enhanced functional properties.

For this purpose firstly were prepared two types of precursor solutions: a solution of 50% tetrahydrofuran (THF) in polydimethylsiloxane-α,ω-diol and a second solution of 10% cobalt blue (CB) in THF. In the second solution a 10% hexamethyldisilazane was added as a compatibilizing agent with the silicone matrix.

The two solutions were mixed in certain ratios to obtain different solutions with ratios CB/PDMS of 1, 2, 5, 10, 20 and 50%, To the resulting mixtures certain quantities of tetraethyl orthosilicate were added to have solutions with 3% tetraethyl orthosilicate compared to the amount of PDMS as a crosslinking agent and 0.1 ml of dibutyltin dilaurate (DBTDL) as a crosslinking catalyst. The mixtures were stirred for a few minutes, casted as layers on a Teflon substrate, and left for two weeks to evaporate and mature.

The structure and morphology of so obtained composite layers were analysed by X-ray diffraction and scanning electron microscopy. To investigate their functional properties optical, mechanical and actuation measurements were performed. The best mechanical and actuation properties were evidenced for the 20% CB/PDMS composite layer.