Hybrid poly(vinyl acetal)s / silica nanoparticles thin films for optical sensing of humidity

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Poly(vinyl alcohol) (PVA) thin films are widely used for humidity sensing due to their high sensitivity towards water but have some drawbacks such as instability at high levels of humidity, nonlinearity and presence of hysteresis. In this study, in order to improve PVA sensing properties hybrids comprising hydrophobically modified PVA copolymers and silica particles were utilized as humidity sensing media.

Series of poly(vinyl alcohol-*co*-vinyl acetal) copolymers (PVAac) with acetal content in the range 18-28 % were synthesized by partial acetalization of hydroxyl groups of PVA with acetaldehyde. Copolymer solutions of concentration 1 wt % in mixed water-methanol solvent (20:80 volume ratio) were used for thin film deposition via spin-coating method. To obtain hybrid polymer-silica thin films, SiO_2 particles were *in situ* generated in copolymer solutions via the sol-gel method. Properties of PVAac and PVAac-SiO_2 films were compared in terms of optical constants, sensing behaviour toward different levels of humidity and sensor element characteristics like sensitivity, hysteresis and reflectance change (ΔR or color change). It was shown that acetal modified PVA films doped with appropriate amount of SiO_2 particles offers linearity in the entire humidity range. The feasibility of hydrophobically modified PVA thin films for optical sensing of humidity is demonstrated and discussed.

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