Label-free detection of viruses using liquid crystals on a polymeric surface with periodic nanostructures

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Abstract. In this study, we demonstrated a label-free detection of viruses using liquid crystals (LCs) on a polymeric surface with periodic nanostructures. The polymeric nanostructures, which hold sinusoidal anisotropic patterns, were created by a sequential process of poly-(dimethylsiloxane) buckling and replication of the patterns on a poly-(urethane acrylate) surface containing a film of gold. After immobilization of human cytomegalovirus- and adenovirus-antibodies onto the polymeric surface treated with a mixed self-assembled monolayer, a uniform appearance reflecting the uniform orientation of 4-cyano-4'-pentylbiphenyl (5CB) was observed. Conversely, binding of viruses to their antibody decorated surface induced a random appearance of 5CB from the random orientation of 5CB. The uniform to random orientational transition of 5CB indicates that the anisotropic topography of the polymeric surface was masked after specific binding of viruses to the antibody decorated surface. We evaluated the specificity of the binding events by confirming topographical changes and optical thickness using atomic force microscopy and ellipsometry, respectively. These results demonstrate that polymeric surfaces with continuous anisotropic patterns can be used to amplify the presence of nanoscopic virions into an optical response of LC, as well as expand the scope of LC-based biological detection on polymeric solid surfaces.

Keywords: Liquid crystals; Polymeric surface; Detection of viruse; Adenovirus Human cytomegalovirus.