Strip Coating Metrology on Large Scale Telescope Optics: Scalable Cost Saving Preventative Maintenance with First Contact Polymer

James Hamilton, University of Wisconsin-Platteville

Protection and cleaning of precision optical surfaces on large scale astronomical instruments has entered a new era. First surface mirrors have been restored to "like-new" condition avoiding the expense and downtime of recoating. Nearly 10 years of testing and evaluation at a variety of sites including optics at Vandenberg Air Force Base, the Canada France Hawaii Telescope (CFHT) and the W.M Keck Telescope on Mauna Kea, have yielded impressive results: restored reflectivity, no residue, insitu cleaning and better coating performance when used as a precleaner when coating. Metrology and research in our labs has resulted in these novel, commercially available polymeric stripcoatings that are applied as a liquid and subsequently peeled off the substrate as a solid film. These designer polymer solutions safely clean and protect a wide variety of nanostructured surfaces and leave the surface almost atomically clean. Contaminant removal was monitored by a variety of techniques including Reflectivity, Nomarski, Atomic Force and Scanning Electron Microscopy as well as XPS. In addition, data demonstrates that the material safely removes particulate contamination and finger oils from nanostructures such as the 300nm wide lines on diffraction gratings and similar submicron features on Si wafers. High power laser damage testing found no residue on the optical surfaces following dried film removal and YAG laser damage thresholds after cleaning on coated BK7 of 15J/cm2 at 20ns and 20Hz were unchanged. Additionally to these adhesion tunable polymer systems, nanotube and graphene doped, ESD free polymer strip coatings for surface protection, nanoreplication, cleaning and dust mitigation have also been developed. Our coatings have been successfully used on diverse surfaces like high power laser optics, the Hope Diamond in Washington DC, CCD s for the 520 megapixel Dark Energy Survey Camera being built at Fermilab and lithographically fabbed detector surfaces for the Cryogenic Dark Matter Search.