Faculty of Engineering and Applied Science

Chemical Engineering Seminar Series

Laser-induced optical nanostructures in azobenzene compounds

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ABSTRACT

Holographic nanostructures can be photo-induced as surface-relief in azobenzene-containing solid thin-films upon laser irradiation at an absorbing wavelength. This phenomenon occurs due to the repetitive cis-trans photo-isomerization of the azobenzene chromophores, yielding mechanical surface deformations apparent at the macroscopic scale. For instance, surface-relief diffraction gratings can be inscribed on azo thin-films upon exposure to a collimated laser interference pattern. The inscription of nanostructures on azo films can be done in under a minute and consists of a single fabrication step. This makes them highly advantageous compared to other nanofabrication techniques. The resulting nanostructures are stable over time and can be coated with other materials, depending on the application. We developed novel fabrication techniques to inscribe precise and predictable linear and non-linear grating structures on azo thin-films. Upon coating these nanostructures with a thin metallic layer, surface plasmons could be generated. These plasmons are resonant electromagnetic waves that propagate at the boundary between the metal layer and an adjacent dielectric medium. Upon the excitation of a plasmon, the local electromagnetic fields at the boundary are highly amplified. These fields could extend up to 200 nanometers above and below the interface and they result in light entrapment and enhanced transmission through the metallic layer. This makes them great candidates for photocurrent enhancements in thin-film solar cells. Also, surface plasmons are normally generated if several parameters are simultaneously satisfied. This fact allows them to be also used as sensors. We have measured significant photovoltaic efficiency increase in organic thin-film solar cells due to these plasmonic nanostructures, as well as detected the binding of proteins at the interfaces.