OPTOMECHANICS OF SMALL-SCALE STRUCTURES

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While size effects in mechanical properties have been a core focus of this community, size effects in optical properties exhibit different mechanisms. They range from interference in transparent materials over strong interference in lossy dielectrics or semiconductors to plasmonics in metal nanostructures. This paper will attempt to demonstrate these effects by examples of titania/silica Bragg reflectors, strong interference from Ge, Si, GST and AlN to plasmonics in Au, Ag and Cu alloys.

The ability to manipulate light enables applications such as colour switching in passive displays, optical detection of the thermal history of a materials, perfect absorbers and selective absorbers for photovoltaics. On the one hand, all of these applications require mechanical integrity for their reliable operation and on the other hand, an understanding of the interaction of light with metallic structures also allows for a the use of light for the measurement of mechanical properties.

The second part of this paper will focus on the use of light to detect deviatoric elastic strain in thin films and nanostructures. First, this will be presented on an averaging scale over a large ensemble of grains, where the complication arises to differentiate bulk band-structure contributions from surface topography related plasmonic contributions. Second, following an own development of a reflectance anisotropy microscope, elastic strain maps of nanostructures in Au and Ge will be presented that also necessitate the differentiation of plasmonic edge and antenna effects from local crystal orientation and band structure distortion by elastic strain. The solution of these challenges will allow the mechanical testing of thin films as thin as only tens of nanometres.