Molecular alignment on polymer surfaces and deposition with pulsed laser beams

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The experimental use of polarized light to fabricate an alignment layer for liquid crystal display is reported with a cw light source. However, a cw light source has a difficulty to align a high Tg polymer such as polyimides which decompose rather than flow at a very high temperature. Pulsed laser beams, when absorbed in the surface, heat up the surface to a very high temperature instantaneously and then cool down very quickly. Although polyimides normally decompose without melting, they show laser induced periodic surface structure (LIPSS) under polarized pulsed laser irradiation,[1,2] indicating polyimides melting for a short period under pulsed laser irradiation. LIPSS are not limited to polyimides, but extended to poly(ethylene-terephthalate)(PET), polysulfones, polystyrene and others.

Surface molecular alignment in LIPSS areas is demonstrated by a dichroism of reflected FT-IR spectroscopy and also liquid crystal alignment placed on top of the polymer films showing LIPSS.[3] Our interest is not limited to well developed LIPSS but areas with weak pulsed laser irradiation. Even though there is no LIPSS observed, yet still polymer surfaces are aligned as demonstrated by liquid crystal alignment and the dichroism. With PET the C=O stretching in the LIPSS became parallel to polarization *p*-plane of the pulsed laser used.

Polyimides LIPSS were also used for fabricating 100nm Si structures using a series of reactive ion etching processes. Diamond and diamond-like carbon (DLC) were deposited on top of such 100nm Si structure using pulsed laser photoablation of poly(methyl methacrylate) in presence of oxygen or hydrogen . Imagewise nano-sized diamond and DLC deposition may become important in some applications such as low-voltage electron sources.