Photoinduced magnetic changes in fullerene films

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Phototransformation of bulk C60 fullerite in air as well as laser and electron beam C60 film treatment leads to the appearance of weak, but measurable magnetic features.

Laser irradiation of the films is followed by the changes in magnetic properties which can be visualized by magnetooptical methods. Photochemical reactions proceed in the surface layers of films. The transition from the van der Waals bonded solid to a chemically bonded one contracts the lattice. Stresses in the phototransformed layer lead to the breaking of already formed polymerized patterns; therefore the topological grains appear on the film surface. The magnetic images are correlated with the topographic ones, and they appear only if the irradiation proceeds in the presence of oxygen.

The light-induced oxidation (“degradation”) has been extensively studied, but the structure of this phase is less clear and evidently more treatment-dependent than that of photopolymers. Both photopolymerization and oxidation processes are initiated by excitation of electrons beyond the energy gap between the HOMO and the LUMO bands of C60 . The oxygen-phototransformed films have a general formula C60(O2)x where x depends on wavelength, light intensity, dose of irradiation and sample crystallinity. Photopolymers can be reverted to the pristine state by low heating, while the C60(O2x phase is only partially reversible. Here we present the research into the structural and magnetic changes in laser-exposed fullerene films depending on the irradiation conditions and film crystallinity.