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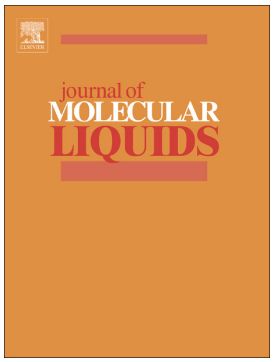

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High-quality alignment of nematic liquid crystals using periodic nanostructures created by nonlinear laser lithography

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ABSTRACT

It is well known that today two main and well studied methods for alignment of liquid crystals has been used, namely: rubbing and photoalignment technologies, that lead to the change of anisotropic properties of aligning layers and long-range interaction of the liquid crystal molecules in a mesophase. In this manuscript, we propose the usage of the nonlinear laser lithography technique, which was recently presented as a fast, relatively low-cost method for a large area micro and nanogrooves fabrication based on laser-induced periodic surface structuring, as a new perspective method of the alignment of nematic liquid crystals. 920 nm periodic grooves were formed on a Ti layer processed by means of the nonlinear laser lithography and studied as an aligning layer. Aligning properties of the periodic structures of Ti layers were examined by using a combined twist LC cell. In addition, the layer of the nanostructured Ti was coated with an oxidianiline-polyimide film with annealing of the polymer film followed without any further processing. The dependence of the twist angle of LC cells on a scanning speed and power of laser beam during processing of the Ti layer was studied. The azimuthal anchoring energy of Ti layers with a periodic nanostructure was calculated. The maximum azimuthal anchoring energy for the nanostructured Ti layer was about 4.6×10^{-6} J/m^2, which is comparable to the photoalignment technology. It was found that after the deposition of a polyimide film on the periodic nanostructured Ti layer, the gain effect of the azimuthal anchoring energy to ~ 1×10^{-4} J/m^2 is observed. Also, AFM study of aligning surfaces was carried out.

Keywords: Aligning layers; Azimuthal anchoring energy; Polyimide; Nematic liquid crystals; Nonlinear laser lithography; Nanostructured titanium layers

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