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# UV radiation-induced surface wetting changes in lithium niobate single crystals

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**Abstract:**
Irradiation of lithium niobate crystal surfaces with UV radiation modifies the wetting properties of the surface which becomes super-hydrophilic. This effect is used for spatially selective attachment of chemical species on the laser exposed areas.

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The interaction between highly absorbed UV laser radiation and the z-faces of lithium niobate single crystals has been reported to induce modification of the surface reactivity with chemical etching agents such as hydrofluoric acid (HF) [1,2]. This effect has been attributed to the photo-excitation of charges which are subsequently trapped in defect sites producing a spatial charge distribution that corresponds to the illuminating pattern.

In this contribution we show that the UV laser-induced surface charge distributions interact sufficiently with the polar molecules of various solvents to increase their attachment to the surface hence changing the wetting behaviour of the surface without changing the surface topography (surface roughness). The wetting modified area corresponds strictly on the illuminated surface areas. We have observed such wetting modifications even in submicron regions (0.7 μm) after illumination through an appropriate phase mask. Figure 1 shows the spreading of a de-ionized water droplet on a) non-exposed and b) pulsed laser exposed areas. The contact angle of the droplet with respect to the surface before UV illumination was of order 110°. After UV illumination the contact angle became 180° as shown in figure 1b. Finally, the UV laser induced wetting modification of the surface recovers completely after a few days at room temperature or faster by thermal annealing at ~200° C for 2 hrs.

Pulsed and c.w. laser radiation from a KrF excimer laser (248 nm) and frequency-doubled argon-ion laser (244 nm) respectively were used to illuminate the +/- z surfaces of commercially available lithium niobate single crystal wafers. Selective attachment of (various amphiphilic molecules, organic dyes, quantum dots, metallic/polymer nano-paticles) on pre-illuminated surfaces will be presented. Lithium niobate is a nonlinear ferroelectric material possessing very useful physical properties. Additionally it is an excellent host for active and passive optical waveguides. The ability for precise spatial arrangement of organic/inorganic molecules and nano-particles has the potential to offer valuable solutions to device fabrication.

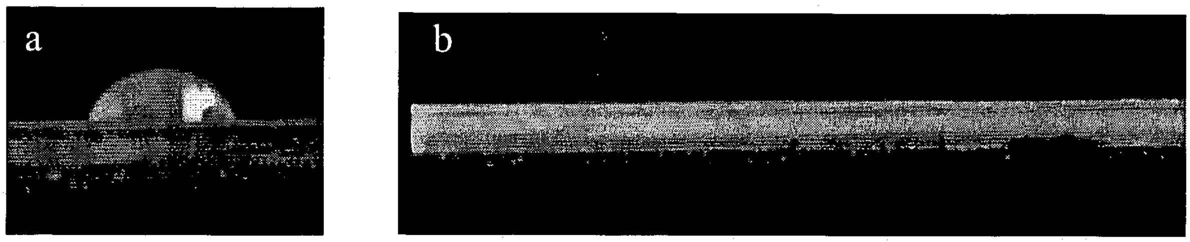


**Figure 1** a) de-ionized water droplet on the +z face of a lithium niobate single crystal wafer, the contact angle is ~110° b) after UV exposure the same volume of water spread readily on the illuminated surface

1. S. Mailis, C. Riziotis, P. G. R. Smith, J. G. Scott, and R. W. Eason, "Continuous wave ultraviolet radiation induced frustration of etching in lithium niobate single crystals."Appl. Surf. Sci. **206** (1-4), 46 (2003).
2. S. Mailis, P. T. Brown, C. L. Sones, I. Zergioti, and R. W. Eason, "Etch frustration in congruent lithium niobate single crystals induced by femtosecond ultraviolet laser irradiation." Appl. Phys. A **74** (2), 135 (2002).