Adsorção induzida por luz laser de átomos alcalinos em superfícies dielétricas.

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Sinopse. We describe a technique to laser-induce the adsorption of alkali atoms on a dielectric surface. Using this technique we are able to control the growth of a metallic film with arbitrary shape and nanometric thickness resolution. We discuss the role of the laser light and the surface conditions needed to implement the laser-induced adsorption technique.

We describe here a technique to grow a metallic ultra-thin film on dielectric surfaces by way of laser-induced-adsorption of atoms from a low-pressure vapor [1,2]. A cw low-power (<100mW) laser beam is sent to the interface of a transparent dielectric surface (quartz or sapphire) and a low-pressure alkali vapor (P < 100 mTorr). The vapor is contained in an evacuated sealed cell, whose background pressure is < 10^{-7} Torr. When the laser frequency is resonant with the vapor atomic transition we observe the growth of a metallic film on the dielectric surface. Such a film has a shape defined by the spatial profile of the laser beam (see Fig. 1) and a thickness controllable with nanometric resolution. The mechanism of the laser-induced film growth is as follows [2]: for the range of pressure explored in the experiment, the laser beam is totally absorbed in a depth less than a nanometer from the surface, by the highly polarizable alkali vapor; some of the atoms might absorb three photons and be ionized very close to the surface. Those photo-ions may strongly stick to the surface if the ions are neutralized. Therefore, to build up a multilayer film a net charge from the surface must be transferred to the ion. The probability of ion neutralization is related to the surface electronic state prior to the beginning of the laser illumination. Indeed, the surface in contact with the vapor is cesiated by atoms thermally adsorbed in the van der Waals potential. The surface cesiation depends on the vapor pressure and imposes a minimum vapor pressure for the film to form.

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Here we discuss in details this laser-induced-adsorption process and we show that a minimum cesiation is needed to allow the film to grow. Moreover we discuss how such a minimum cesiation is related to a mechanism of the surface charge neutralization.

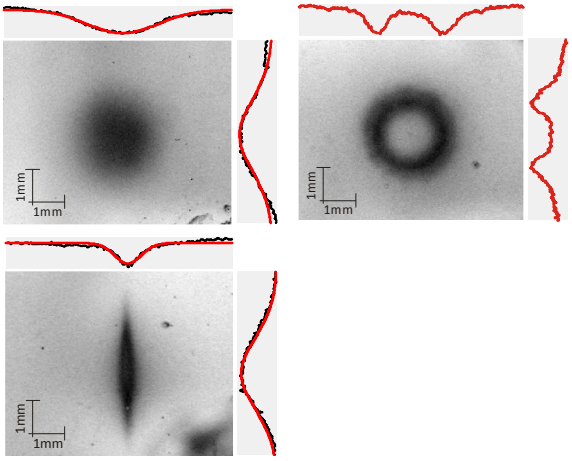

Figure 1. Pictures of laser-induced metallic films obtained with a beam of Gaussian, ring, or linear profiles.

Referências

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