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PHOTODESORPTION OF ALKALI METAL ATOMS FROM DIELECTRIC SURFACES

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The results of experimental studies of photodesorption of potassium atoms from the glass and sapphire surfaces and rubidium atoms from the glass surface are presented. The dependence of the desorption probability on the laser pulse intensity is obtained. The power density at which thermal desorption prevails over photodesorption is found. The sticking probability of the atoms colliding with the surface is determined. The adsorption energies of rubidium and potassium atoms on glass have been measured.

Alkali metal atoms are used in magnetometers [1] and frequency standards [2]. It is possible to implement rubidium vapor lasers [3]. Alkali metals are used as a material to create Bose-Einstein condensate [4]. Moreover, they have good prospects for application in quantum computer elements [5].

In connection with the miniaturization of devices, it is necessary to study the interaction of the atom with the surface as in the nanoscale devices atoms frequently interact with surfaces. Frequent collisions of the atoms with the surfaces lead to a loss of their polarization. As a comprehensive theory of the atom-surface interaction still lacks, experimental studies of the interaction of alkali atoms with the surfaces of wide-band dielectrics becomes of great importance.

Potassium and rubidium atoms have been chosen for our experimental studies because their resonance transitions lie in the optical and near IR- ranges and the high enough vapor pressure of these atoms may be achieved at relatively low temperatures. The glass and sapphire surfaces are chemical inertness to alkali metals and transparent in such wavelength range. The desorption of alkali metal atoms from the glass/sapphire surface has been by the second-harmonic radiation of a neodymium laser operating in the pulse mode (λ = 532 nm, pulse duration 10 ns). The beam diameter has been chosen 3 mm. The registration of desorbed atoms flux has been out by measuring the changes in the absorption of radiation of a continuous narrow-band semiconductor laser, tuned to the D_2-line of Rb atom (λ=780 nm) or D_1-line of K atom (λ=770 nm).

The dependences of the desorption probability on the intensity of laser pulses has been determined. The threshold energy density at which thermal desorption prevails over photodesorption is found for Rb and K atoms on different surfaces. The dependence of the amount of the desorbed atoms on the repetition rate of the desorbing pulses is obtained. There is a sharp decrease in surface concentration of adsorbed atoms at frequencies above 1 Hz. The sticking probability of the atoms colliding with the surface is determined. The adsorption energies of rubidium and potassium on glass has been measured and compared with the known values for sodium [6].

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