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Surface plasmon resonance in C_{60} fullerite LB films on Ag polycrystal film

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Morphology of C_{60} fullerite Langmuir-Blodgett films of various thickness on Ag polycrystal surface prior to and after annealing, Ar^+ ion etching and Sm metal thermal diffusion has been studied using the surface plasmon resonance (SPR) method. The complex dielectric constant and dispersity of LB films have been calculated. The optical conductivity of C_{60}/Sm films has been estimated basing on the SPR band broadening. The doping with Sm has been shown to result in the LB film density and uniformity over the thickness.

Методом поверхностного плазмонного резонанса (ППР) исследована морфология пленок Лэнгмюра-Блоджетт фуллерена C_{60} различной толщины на поверхности поликристаллического Ag до и после отжига, травления ионами Ar^+ и термодиффузии металлического Sm. Рассчитана комплексная диэлектрическая проницаемость и дисперсность ЛБ пленок. На основе анализа уширения линий ППР сделана оценка оптической проводимости пленок C_{60}/Sm. Показано, что допирование Sm приводит к увеличению плотности и однородности ЛБ пленок по толщине.

The discovery of metal and superconductive states in C_{60} based fullerites has stimulated intense studies of the metal and metal ion doping effect on the material physicochemical properties. The superconducting transition of fullerites doped with alkali metals is associated with the transition and occupation of the C_{60} t_{lu} molecular level (LUMO) by electrons of the corresponding metal and with metal-fullerenes (Me_3C_{60} where Me = K, Rb, Cs) formation [1].

As for fullerites doped with alkali-earth metals, such a transition was observed under higher metal phase concentrations [2], although the recent studies of Li_xC_{60} systems evidence only semiconductor type conductivity [3]. The single-electron intermolecular transfer probability in a metal-fullerene system has been shown to be rather high when the work of electron exit for the metal is less than 3.5 eV [4]. The fullerite doping with lanthanides having the work of exit lower than 3 eV can be expected to favor the metal state of fullerite structures [5].

In most cases, the fullerite physical properties were studied using vacuum-deposited films on various substrates. The Langmuir-Blodgett (LB) technique offers an alternative method to form thin fullerite films [6], since the C_{60} molecules are ideally hydrophobic and capable of the insoluble Langmuir layers formation on the aqueous subphase. There are few study results concerning C_{60} LB films which are contradictory. For example, the fullerene has been shown to be transferred onto Ag substrates as bilayer films of d = 1.9 nm thickness [7] (the buckyball molecule having Van-der-Waals diameter of 1.12 nm [1]). On the other hand, according to [8], the C_{60} layers are transferred onto quartz and amorphous carbon substrates as the solid phase islands. These are accumulations of molecular layers having thicknesses from 1 nm to several