Synthesis of CuInS_2 through laser impulse processing of Cu-In bimetallic films in sulphureous fluids

M.I. MARKEVICH, F.A. PISKUNOV and V.A. YANUSHKEVICH

Institute of Electronics, Byelorussian Academy of Sciences, 22 Logoiskii Trakt, 220841 Minsk, Belaruss

Laser synthesis of thin films of semiconducting compounds is a highly promising method in microelectronics. It is technologically simple and makes possible the control of the size of thin film structures. The processing of single- and multilayered films in chemically active media is markedly non-linear in the kinetic parameters of the reaction which facilitates the synthesis of single-phase films (i.e. through "phase selection") with specific chemical and physical properties.

The paper features the synthesis of CuInS_2 through pulsed laser treatment of bimetallic Cu-In films in sulphureous fluids. CuInS_2 is currently regarded as a promising material for high efficiency solar cells. Non-stoichiometric bimetallic Cu-In films ($0,5\mu\text{m}$ Cu + $0,2\mu\text{m}$ In) on glass ceramic bases, used as samples, were irradiated by single pulses of an Nd-glass laser under a layer of sulphureous fluid 1,5-2,0 mm thick containing 80 g per litre of sulphur. The samples were processed in the free-lazing ($\tau = 5 \cdot 10^{-8}$ s) and Q-switched modes ($\tau = 10^{-3}$ s) with power density equal to $(1,2-1,4) \cdot 10^9$ and $3,3 \cdot 10^4 - 1,0 \cdot 10^6$ Wt/cm², respectively. The X-ray analysis has revealed that the formation of CuInS_2 is restricted to the samples processed with ultrashort high-power pulses. No traces of CuInS_2 have been detected in the samples treated by single pulses of 10^{-3} s in the given power density range.

Selective formation of CuInS_2 phase in the free-lazing mode can be explained in terms of retarded chemical relaxation of the reacting system and the shock wave generated by ultrashort laser pulses in the process fluid and accelerating the chemical reaction.