Non-equilibrium spin dynamics in dilute magnetic semiconductor under optical polarization spin of electrons and carrier-warming electric field

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In this paper we present the new results of theoretical studies concerning the action of carrier-warming electric field on non-equilibrium spin polarization of the electrons in a diluted magnetic semiconductor with parameters of n-InP:Fe. We considered a sample illuminated by a circular polarized light with a frequency satisfying the condition of impurity absorption. The dynamics of the carriers was described by one-dimensional system of non-linear differential equations in partial derivatives, including the continuity equation for spin-polarized electrons in conductivity band and at the impurity level, as well as the Gauss law. We investigated the evolution of phase portraits of the system, maximum Lyapunov exponent and Hausdorff dimension as functions of applied electric field. It was found that the space-time distributions of band electron concentration and their spin polarization degree could be represented as a superposition of high- and low-frequency harmonics with different amplitudes. The system studied proved to be stable towards the variation of the external factors. Depending on the applied field and other control parameters, the electron system studied can be efficiently switched between five possible stable states. Alternatively, it may be forced to stay in five-times degenerated state, deterministic state, or quasi-chaotic state. The results obtained offer important insights for the construction and optimization of spintronic devices based on diluted magnetic semiconductors.