# ФІЗИКА І ТЕХНОЛОГІЯ ТОНКИХ ПЛІВОК ТА НАНОСИСТЕМ

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# On the Analytical Parameterization of Photoinduced Darkening in Amorphous Chalcogenide Films

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Despite recently achieved progress in phenomenological description, some peculiarities of photoinduced effects in thin chalcogenide films need a deeper understanding. This concerns, in part, kinetics behavior observed in the change of optical properties of amorphous films caused by activated light of different penetration ability. In this research, we deal with both thickness and compositional trends in the photodarkening kinetics by testing films of different thicknesses, thermal pre-history and chemical compositions ($As_{40}Se_{60}$, $As_{50}Se_{50}$ and $As_{60}Se_{40}$) in terms of photon-assisted site switching (PASS) facilitating percolative growth of atomic clusters at ground state.

Within this formalism, the final photodarkened sites (independently on their population and origin), having higher energy, are supposed to be formed from original sites, giving a dynamic interbalance owing to straightforward (production) and backward (relaxation) activation reactions. These photoinduced production-relaxation processes terminated by corresponding initial and boundary conditions can be conveniently presented via a set of first- or second-order differential rate equations.

In the framework of this scheme, it was established that photodarkening itself in the studied arsenoselenide films is non-dispersive in nature, its kinetics description being first-order and governed by penetration depth of pumping light (the inverse value to the absorption coefficient). In the case of films thicker than a penetration depth, the photodarkening kinetics attained a character stretched exponential behavior, while in thinner films (with thickness less than a penetration depth) the stretched exponential relaxation tented to be single exponential. With illumination by over-bandgap photons effectively absorbed by amorphous chalcogenide film, more photostructural processes proceed simultaneously giving resulting stretched exponential kinetics, while low-absorbed light causes nearly ideal single exponential darkening kinetics.