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PHOTODARKENING DESCRIPTION IN THIN CHALCOGENIDE FILMS

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Photoinduced effects in thin films of binary As-Se section are known to be revealed in their darkening, clearly demonstrating two different components in dependence on film composition and illumination parameters, the transient occurring under in-situ photoexposure along with metastable remaining after illumination stopping. Strict information on the kinetics of these effects is important in view of possible application of chalcogenide films for optical information storage. Nevertheless, a number of discrepancies exist on the matter of this question. Thus, in [1,2], there were concluded that universal stretched exponential relaxation low always gives better agreement with experimental data on photodarkening kinetics in As-S/Se films independently on their thickness, even for measurements performed at low temperatures (78 or 4.2 K), when penetration depth of pumping light is increased because of tempe re dependence of optical band gap. An opposite decision on simple exponential kinetics for in-situ photoda ning in $As_2(S/Se)_3$ films illuminated by over-gap photons was put forward later as an exemplification of top controversy in this field [3,4]. With illumination by over-gap photons effectively absorbed by this film, more photostructural processes proceed simultaneously giving a stretched exponential kinetics, while low-absorbed light causes ideal single exponential photodarkening kinetics.

In this work, the kinetics of in-situ photodarkening was carefully examined at the example of $As_{100-x}Se_x$ films to justify its revealing under a wide variety of experimental-measuring conditions. We choose $As_{40}Se_{60}$, $As_{50}Se_{50}$ and $As_{60}Se_{40}$ films of different thicknesses and thermal pre-history pumping with the same absorbed light having different penetration depths. It is shown the photodarkening kinetics strongly depends on penetration depth: in case of film thickness greater than penetration depth, this kinetics can be described by stretched exponential function, while in thicker films, the stretched exponential relaxation tents to simple exponential one. The principal conclusion well agreed with [5] is that in-situ photodarkening itself is governed by single exponential rule, but in dependence on the penetration depths of pumping light this behaviour attains a stretched character.

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