

Edmonds *et al.* Reply: (Ga,Mn)As is a test ground of choice in semiconductor-based spintronics research. This is due, in particular, to the development of annealing procedures that substantially improve its electric and magnetic properties. However, the quality of (Ga,Mn)As has not been fully optimized yet; thus, understanding the exact nature of defects and their annealing and passivation is highly interesting. The Comment by Adell *et al.* [1] represents an attempt in this direction.

Adell *et al.* study the influence of annealing of (Ga,Mn)As covered by a capping layer of amorphous As on the Curie temperature T_C . They confirm the main conclusion of our paper [2], namely, that the removal of defects by annealing of (Ga,Mn)As occurs in two steps: (i) the out diffusion of interstitial Mn (Mn:I) toward the surface, followed by (ii) electrical passivation of Mn:I donors by the formation of, e.g., an oxide (which increases the hole concentration and the Curie temperature). In [1], Mn:I diffuses towards the (Ga,Mn)As/As interface, where it is passivated by formation of MnAs.

Comparing Ref. [1] with Ref. [2] it is noted that (a) during the first two hours the kinetics of annealing is faster in [1] (however, not “by 1–2 orders of magnitude” as is claimed by Adell *et al.*); (b) time required to reach the maximum T_C in [1] is independent of the thickness of the samples, in contrast to Ref. [2]; (c) in [1] the initial rise of T_C is followed by a degradation of sample, while we find that annealing of uncapped samples leads to a continuous improvement, even after much longer times, and higher T_C .

From the point (a) Adell *et al.* suggest that in [2] the process limiting the kinetics of annealing is not the bulk diffusion of Mn:I but the formation of a protective oxide layer at the surface. Although surface accumulation of Mn oxide certainly occurs in air-annealed samples, as demonstrated by the Auger spectra in Fig. 2 of [2], we see no evidence that the passivation rate decreases as the oxide thickness increases. Such an effect would break the $(1/L^2)$ -scaling of the diffusion rate, which is clearly observed in our study over a 2 orders of magnitude change of L^2 . We agree that in principle a reduced passivation rate will reduce the annealing efficiency, however the results of Ref. [1] are too incomplete to be conclusive.

Point (b) is ascribed in [1] to the formation of a reacted MnAs layer that hinders further passivation. Therefore, the “optimum” anneal time observed in [1] corresponds to the

time required to form a reacted layer, rather than the time required for complete out diffusion of interstitials.

The degradation induced by longer annealings, point (c) above, is unexplained, and is usually only observed on annealing at much higher temperatures [3]. Since we do not observe this effect, it should be due to the presence of the As capping layer. One may speculate that this is caused by the in diffusion of As and formation of As-induced donors, e.g., As antisites, facilitated by the low position of the Fermi level. Independent of the actual cause of the degradation, the usage of the As capping layer proposed by Adell *et al.* is unfavorable compared to annealing in air.

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Received 26 January 2005; published 6 April 2005

DOI: 10.1103/PhysRevLett.94.139702

PACS numbers: 66.30.Jt, 75.50.Pp

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