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STRUCTURAL DEFECTS IN CRYSTALLINE SILICON

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The basic photovoltaic properties of a given crystalline silicon specimen seem to be governed by density and nature of two- to three-dimensional lattice defects. These are mainly generated by primary growth conditions as grain boundaries of more or less intrinsic character or second-phase precipitates from supersaturated solutions of carbon or oxygen. Considerably high values of both solubility and diffusivity in connection with their abundance in common refractory material systems account for the predominance of the two particular elements. Unsaturated dislocations of different types very often can be seen as a consequence of the existence of more-dimensional defects as described initially.

The final performance of a solar cell, however, is dependent of the concentration and distribution of recombination-active centers in the different regions of this device. Typical representatives are fast-diffusing transition metals in form of either single atoms or simple complexes.

Their avoidance, annihilation, or removal has been of great concern in different fields of electronic materials development for years. Presently we are still in a very early stage of thorough comprehension in terms of interaction of metal atoms with the one- to three-dimensional crystal defects discussed.

RAI-CHOUDHURY: What needs to be improved in polycrystalline silicon, without paying a price for solar performance?

SIRTL: (First part of answer not recorded) . . .wouldn't it be better to take a single crystal? It was not the alternative for us in this case, because we didn't work on that, and we didn't even plan to work on that because we wanted to create something that has to be much more economical in the future. But we were pleased to see that grain boundaries in general must not mean, from the beginning, a terrible situation. If we optimize that over the years, in a certain way, we may well end up with something that will just please us to be there. We have seen that people have managed rather well, or very well, in the meantime, to overcome the problem of a grain boundary running through a p-n junction. That is one subject I would say I missed, that has not been brought up explicitly around here, but it may be a subject for some further meeting because, I think we would learn a lot of interesting things.

SCHWUTTKE: May I answer the previous question, if you don't mind? I think that you should not confuse the electrical capture cross section of a defect as its capability to getter impurities. These are two totally different situations. I think it is possible that you can getter impurities, maybe by some mechanism that I don't want to go into right now, but that the electrical capture cross section for electrons of that particular defect is totally different. You may be just fortunate in this respect.

SIRTL: Your point is well taken.