The Direct Role of Hydrogen in the Staebler-Wronski Effect in Hydrogenated Amorphous Silicon

P. Craig Taylor, University of Utah, DMR-20073004

The Staebler-Wronski effect in hydrogenated amorphous silicon (a-Si:H) has been known for over 25 years. This effect is the creation of defects that limit the performance of thin-film transistors and solar cells. The defects are silicon dangling bonds, but hydrogen has long been invoked as important in stabilizing them. We have found a nuclear magnetic resonance signal in a-Si:H due to a paired hydrogen site that correlates with the dangling bonds. The inescapable conclusion is that these paired hydrogen sites stabilize the defects that cause the Staebler-Wronski effect. The elimination of these sites will dramatically improve the devices.

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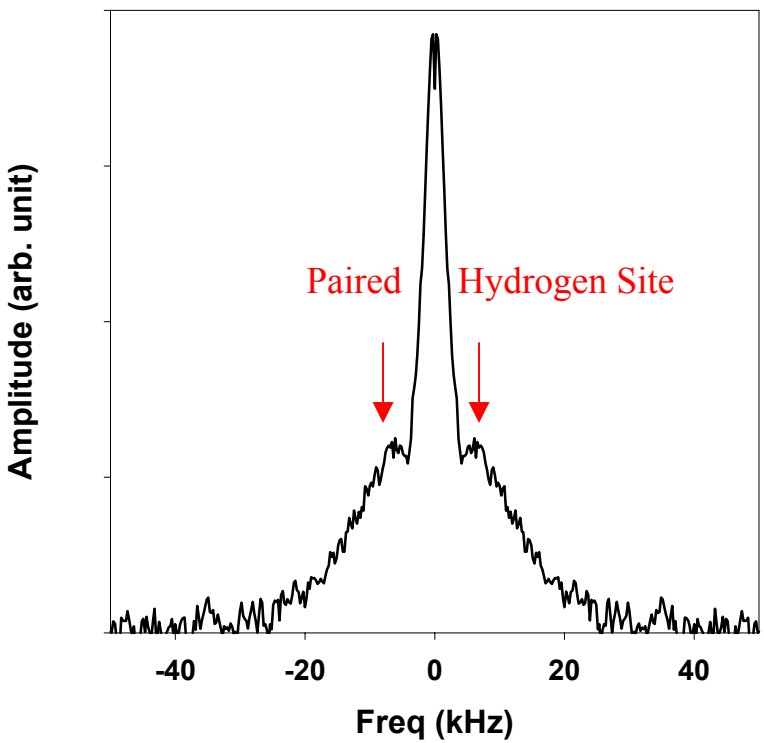

The red arrows indicate the hydrogen "doublet" that stabilizes the silicon dangling bond defects in the Staebler-Wronski effect.

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Education:

Six undergraduates (Jeremy Conlin, Christina Derbidge, Elizabeth Heider, Christie MacDonald, Russell Nagle, and Robin Plachy), five graduate students (Eungho Ahn, Chris Nelson, Jared Olson, Janica Whitaker, and Wei Xu), and one postdoctoral research associate (Tining Su) contributed to this work.

Robin Plachy received a Kennicott Scholarship and a Goldwater Scholarship. Heider and Plachy are now in graduate school. Ahn received his Ph.D. in 2003 and is presently a scientific officer with the Korean National Science Foundation.

Outreach:

Undergraduate student, Christie MacDonald, wins a prize from the 4-Corners Section of the American Physical Society for her presentation at a recent meeting.