**Variability in FeB Pair Association Rates in Silicon under Ultrasound Loading: Effects of Acoustic Wave Types**

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Ultrasound (US) is recognized as an effective tool for defect engineering in materials science, as detailed in sources [1-2]. Its broad utility stems from the ability to modify both the frequency and type of acoustic waves, allowing for a targeted approach to specific defect types. Recent studies [1] have demonstrated that US loading can force an increase in the association rate of FeB pairs in Cz-silicon solar cells, likely due to a lowered energy barrier for iron ion migration. The magnitude of acoustically-induced (AI) energy reduction Δ*E*US is foreseeably dependent on the intensity of the excited acoustic waves (see Figure~1) and can reach up to 15 meV.

Further research revealed an intriguing frequency effect associated with acoustic wave types. Specifically, when FeB association stimulated by longitudinal waves of a constant intensity, the value of Δ*E*US rises with frequency—refer to Fig. 1, left panel. In this scenario, an increase in acoustic vibration frequency leads to decreased efficiency in the acoustic-defect interaction. When transverse ultrasonic waves are excited, the opposite effect is noted: higher frequencies enhance the efficiency of accelerating the association of the FeB pair (see Fig. 1, right panel).

Such behavior of the Fe center in Si under ultrasound loading distinctly demonstrates the presence of an anisotropic deformation field within the crystal lattice linked to this defect.

Simultaneously, the oversized ion core of the Fe impurity is evident in the emission of the elementally specific electron-positron annihilation radiation similar to observations in point defects within diamond-like semiconductors [3]. Such peculiarity must give an identifying feature of the FeB complex in its energetically anisotropic reaction to acoustic oscillations depending on wave type. The FeB complex is regarded as an effective positron trap, and experiments aim to validate predictions concerning the microstructure of the center based on positron annihilation phenomena under US loading conditions will be considered.

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| *Figure 1: Dependencies of acoustically induced changes in iron ion migration energy on ultrasound intensity using longitudinal (L, left panel) and transverse (T, right panel) acoustic waves of different frequencies*. | |

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