The peculiarities of the ultrasound influence on the FeB pair association in silicon structures

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It is well known that ultrasound (US) can be effective tool for defects engineering [1-3]. The wide-ranging US capabilities are closely associated with the ability to adjust the frequency and the type of acoustic waves. Such versatility enables the selection of an ultrasound loading regime tailored to the specific type of targeted defects. Recent research [1] has indicated that US loading conditions can accelerate the association of FeB pairs in silicon solar cells. This effect is believed to result from a reduced energy barrier for iron ion migration:  (where Δ*E*US is the acoustically induced (АІ) change).

Further investigations using silicon *n*⁺-*p*-*p*⁺ structures, aimed at uncovering the mechanisms behind the observed effects, revealed a paradoxical divergence in the frequency dependency of Δ*E*US when using longitudinal and transverse waves. Specifically, under transverse acoustic wave loading, the AI energy change increased with rising of US frequency. In contrast, the frequency rising of longitudinal waves resulted in a decrease in Δ*E*US value. The observed qualitatively different response of FeB center is a reliable and intriguing evidence of anisotropic deformation field tied to this center in the crystal lattice of silicon. There are good reasons to believe that FeB pair is the positron trap and further experiments on verifying predictions for center microstructure based on the phenomenon of the electron-positron annihilation in the field of the ultrasound loading will be considered.

[1] O Olikh *et al.*, *J. Mater Sci: Mater Electron* **2022**, *33*, 13133.

[2] M. Virot *et al.*, *J. Phys. Chem. C* **2012**, *116*, 15493.

[3] D. Kropman, V. Seeman, S. Dolgov and A. Medvids, *Phys. Status Solidi C* **2016**, *13*, 793.

On the whole, such a field inherited out of history of formation of [Fe-B] center is suggestive of drastically different responses to ultrasound loading by longitudinal and transverse acoustic waves. There are good reasons to believe that [Fe–B] center is the positron trap indicating both the open volume and elemental specificity of the atomic ion cores in microstructure of the defect. The oversized ion core of Fe atom reveals itself in emitting the gamma-quanta of the element-specific electron-positron distribution together with the resulting emission of annihilation radiation out of [Fe–B] center, just as it has been observed for point defects of different nature in the diamond-like semiconductors. This emission obeys to both the dynamics and kinetics of rate of positron localization and, as estimated, follows the drastic, qualitatively different response to US loading caused by longitudinal and reverse acoustic waves. Further experiments on verifying predictions for microstructure of [Fe–B] center in both Cz– and FZ–Si based on the phenomenon of the electron-positron annihilation in the field of the ultrasound loading will be considered.

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**Fig. 1.** Dependencies of acoustically induced changes in iron ion migration energy on ultrasound intensity using longitudinal (L) and transverse (T) waves of different frequencies. Points represent experimental data, and the lines are the linear fitted curves.