Supplementary information to

The Electronic Properties of Extended Defects in $SrTiO_3$— A Case Study of a Real Bicrystal Boundary

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Detailed analysis of the photoluminescence properties of dislocations

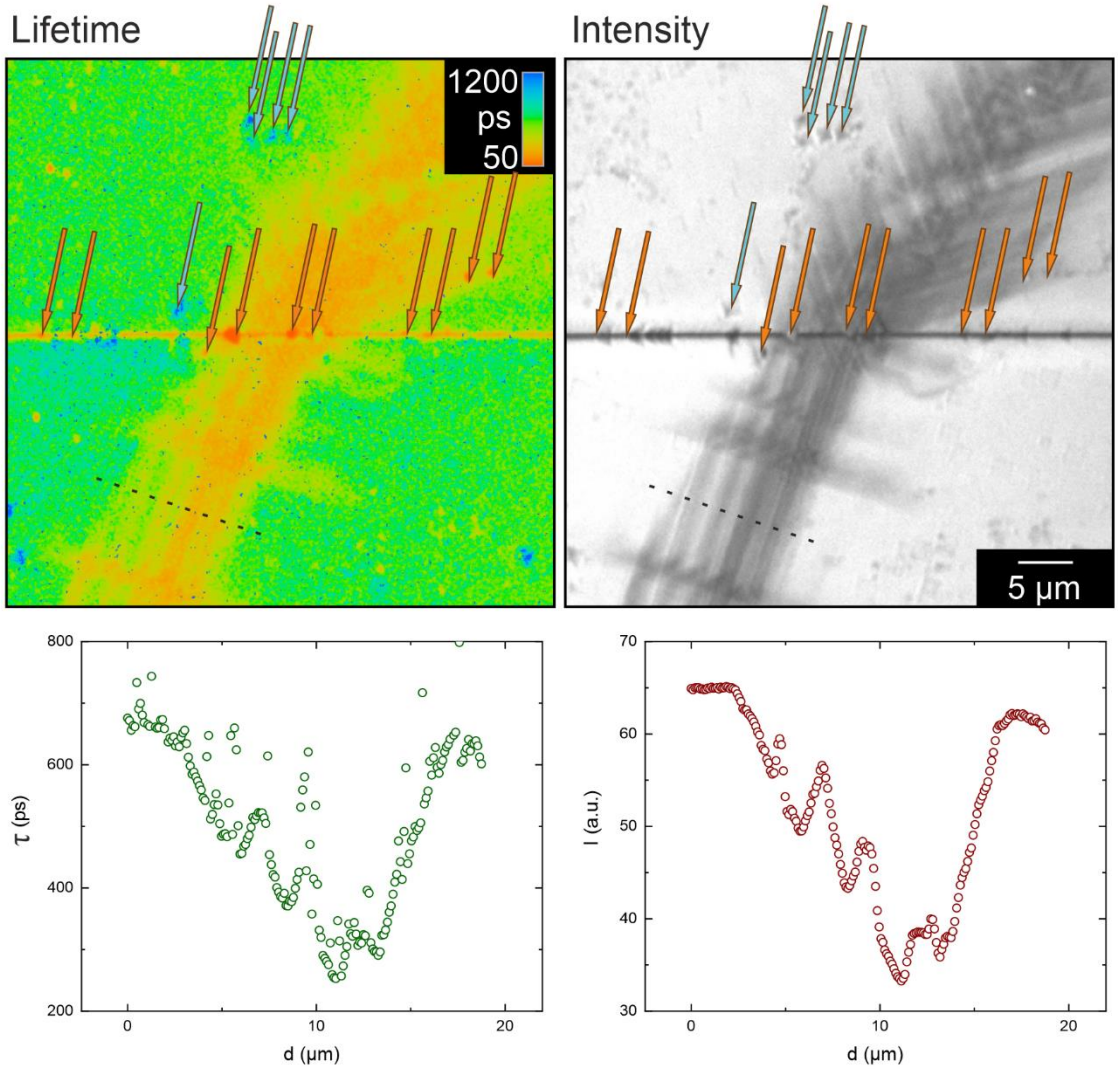

Figure S1. Detailed analysis of the photoluminescence lifetime and intensity measurement on the HF-etched $SrTiO_3$ surface. The arrows mark the position of selected local minima (orange) and local maxima (blue) of the lifetime. Profiles of lifetime and intensity are plotted for the dashed-lines.

Using the FLIM investigation of the $SrTiO_3$ crystal after etching (Figure 11e), we conducted an in-depth analysis of the dislocation's lifetimes. Since etching the crystals in HF leads to the evolution of etch pits preferentially at the exits of dislocations, we can easily identify the position of the dislocations in the intensity images. We marked the positions of selected etch pits in the intensity image and their corresponding position in the lifetime image. Indeed, a direct correlation between dislocations and local lifetime extrema can be observed in Figure S1. There are two types of dislocations, some exhibit a higher lifetime than the surrounding, while some show lower lifetime. As discussed in detail in the main text,

we suppose that two effects play a role. First, it is known that there are two types of dislocations in $SrTiO_3$ with different local structure close to the core of the dislocations. This could result in a deviation from the electronic structure thus altering the photoluminescence transitions. Second, dislocations arranged in dense networks tend to have lower lifetime than isolated ones. Hence, we assume that excited electron-hole pairs can be transported easily along this network to recombination centres resulting in a lower lifetime. In the profiles extracted from the intensity and lifetime maps across the dislocation-rich slip bands, this correlation gets obvious. The traces of lifetime and intensity show the same shape.