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Irreversible surface changes upon n-type doping – A photoelectrochemical study on rutile single crystals

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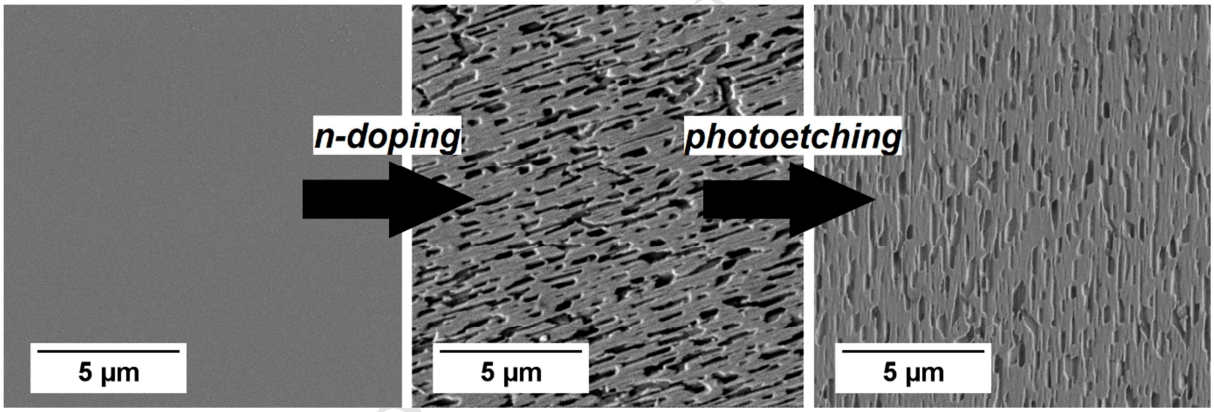
Abstract:



Single crystal wafers need to provide sufficient electrical conductivity to be employed in photoelectrochemical investigations. Usually, their defect concentrations and donor densities are too low to allow electrochemical measurements. Accordingly, TiO_2 rutile single crystal surfaces have to be n-type doped before their electrochemical activity can be evaluated. The doping itself, however, leads to irreversible changes in the surface morphology of the initially smooth crystalline surfaces. In this study, the effects of n-type doping and photoetching on TiO_2 rutile single crystal surfaces have been investigated. The photocatalytic and photoelectrochemical activities of the rutile single crystal wafers have been quantified by methanol photooxidation. The results indicate that n-type doping has different impacts on the employed rutile (100) and (110) surfaces. Subsequent photoetching is necessary to achieve comparable donor densities for both single crystal electrodes. Moreover, the rutile (100) surface is producing different product ratios depending on the applied external bias as compared with the rutile (110) surface for methanol and water oxidation.