

substance: titanium oxide (TiO₂)

property: transport properties in stoichiometric TiO₂ (rutile)

preparation: Single crystal 1 mm thick requires annealing in oxygen at about 800°C for $t > 60$ h. Resistivity $\rho > 10^{13} \Omega \text{ cm}$ in the a and c -direction [72H, 69G]. For $T < 1000$ K, conductivity is mainly ionic [79P] with an activation energy of 0.55...0.75 eV along c -axis and ≈ 2 eV along a -axis.

photocurrent: Photoconductivity is dominated by traps [69G, 73G]. Early reports of significant anisotropy [62H] may have been caused by contact problems [63A]. For highly oxidized samples, the spectra had a maximum at 410 nm [73W] and showed very little intrinsic band gap response [69G]. For more reduced samples, the intrinsic response increases substantially (Fig. 1). Similar results have been reported from photoelectrolytic investigations [80G1]. Temperature dependence of hole and electron mobilities derived from photoconduction: Fig. 2. $E_A(\mu)$ is negative for $T > 100$ K and numerically equal to the Debye temperature, suggesting optical-mode scattering. The decrease in the mobility below 100 K is ascribed to shallow trapping effects. Earlier work suggests field assisted hopping with $E_A^* = E_A - \beta E^{1/2}$, $\beta = (e^3/\pi\epsilon_0\epsilon)^{1/2}$, E = electric field, $E_A \approx 0.08$ eV [72T].

surface photocurrent: Results quite different from bulk photocurrent, Fig. 3.

References:

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Fig. 1.

TiO₂. Photoconductivity vs. wavelength of slightly reduced material (a) and comparison of photoconductivity in highly oxidized TiO₂ with and without empty shallow traps (b) [69G].

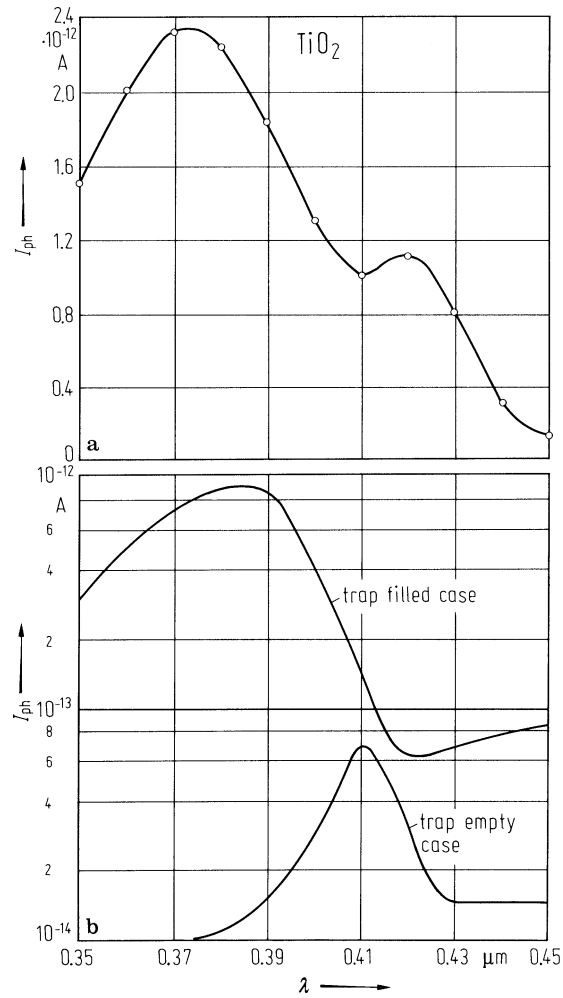


Fig. 2.

TiO₂. (a) Electron and (b) hole mobility along *c*-axis vs. reciprocal temperature for photogenerated carriers. For electrons, μ_n is independent of field strength but (b) shows that μ_p increases with field strength; 1: $2.2 \cdot 10^3$ V/cm; 2: $4.4 \cdot 10^3$ V/cm; 3: $8.8 \cdot 10^3$ V/cm and 4: $17.6 \cdot 10^3$ V/cm [74T].

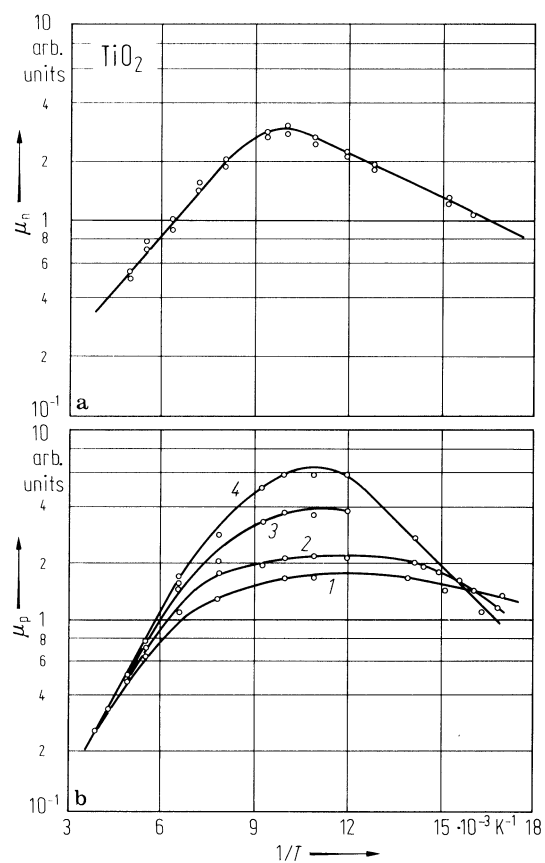


Fig. 3.

TiO₂. Surface photocurrent vs. wavelength at 77 K (full circles) before, (open circles) after exposure to intense white light for (a) as sliced, (b) substitutionally doped with V, Cr, Mn or Fe and oxidized single crystals [80G2].

