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Role of neutral impurity scattering in the analysis of Hall data from ZnO

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Physics, West Virginia University — Zinc oxide is a wide band-gap semiconductor
with bright UV emission. To determine donor and acceptor concentrations affecting
electrical properties in n-type ZnO crystals, the relaxation time approximation has
been used to analyze mobility (\(\mu\)) and carrier concentration data measured from 80
to 400 K. Five scattering mechanisms are included: polar-optical-phonon, piezoelec-
tric potential, deformation potential, ionized impurity, and neutral impurity (NI)
scattering. The NI scattering is often ignored but plays an important role in limit-
ing the total \(\mu\). By including NI scattering, the experimental deformation potential
\(E_1 = 3.8 \text{ eV}\) can be used. Temperature dependences of the intrinsic Hall r factor and
intrinsic \(\mu\) are determined. At 300 K, “pure” ZnO has an electron \(\mu\) of about 210
\text{cm}^2/\text{Vs}. Analysis of Hall data from commercial hydrothermally and CVT-grown
n-type ZnO crystals is presented. Donor and acceptor concentrations from Hall
data are compared with those estimated using infrared absorption and EPR data.
Intrinsic hole mobility in p-type ZnO is also discussed. This work was supported by
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