PATENT ASSIGNMENT

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Invention Title: p-type Iransparent Conducting Oxides And Methods For Preparation

Inventor(s): Thomas Mason, Kenneth Poeppelmeier, Dean Shahriari, Antonine Barnabe

U S. Filing/Issue Date: 12/22/05

Patent or Application Serial No.: 11/316,550

Grant/Contract Number(s): DMR 9632472, AAD-9-18668-05

Foreign Applications filed/intended in (countries): _____

The invention identified above is a Subject Invention under **35 U.S.C. 200, et seq.**, and the Standard Patent Rights clause at **37 CFR 401.14, FAR 52.227-11** or **FAR 52.227-12** (if applicable) which are included among the terms of the above identified grant or contract award from the United State Government. This document is confirmatory of:

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Signed this 8th day of March, 20 06

By Indrani Mukharji, PhD — Indrani Mukharji
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p-TYPE TRANSPARENT CONDUCTING OXIDES AND METHODS FOR PREPARATION

Background of the Invention.

This application claims priority benefit from provisional application serial number 60/281,211 filed on April 3, 2001, the entirety of which is incorporated herein by reference.

The United States Government has certain rights to this invention pursuant to Grant No AAD-9-18668-05 from the Department of Energy and Grant No DMR-0076097 from the National Science Foundation, both to Northwestern University.

This invention relates generally to transparent conducting oxides, and more particularly, to such compositions and related structures having p-type conductivities and methods for their preparation under hydrothermal reaction conditions.

Transparent conducting oxides (TCOs) are degenerate wide band-gap semiconductors with conductivities comparable to metals, but are transparent over the visible and IR regions. Currently, the best known and industrially useful TCOs are doped ZnO, SnO_2 and In_2O_3, all of which are n-type semiconductors. For example, in thin film forms, Sn-doped indium oxide has n-type conductivity on the order of 10^3 S/cm and an average transmittance higher than 85% in the visible light range. By comparison, in thin film form, the p-type conductivity of $CuAlO_2$ is about 1 S/cm and about 10^{-3} S/cm in bulk form. (H. Kawazoe, M. Yasukawa, H. Hyodo, M. Kurita, H. Yanagi and H. Hosono, *Nature*, 389, 939-942 (1997) p-Type Electrical Conduction in Transparent Thin Films of