Nanostructured ZnO Energy Generator: Influence of Dimensional and Mechanical Properties

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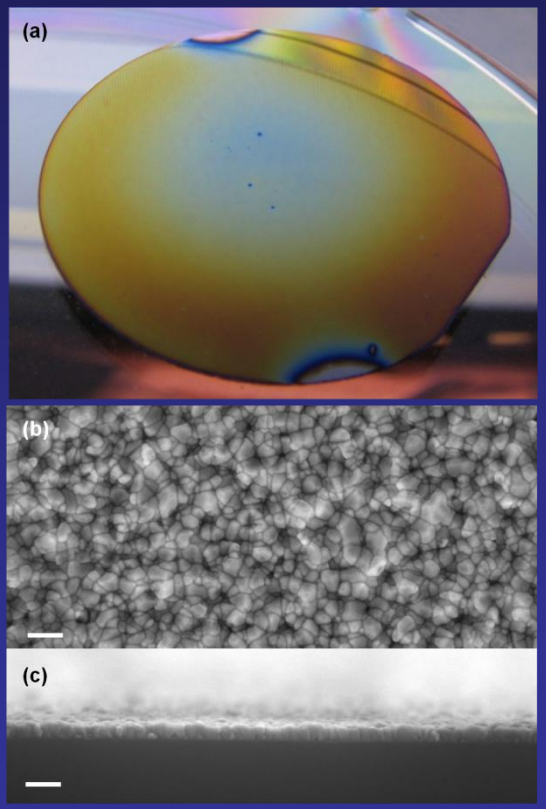
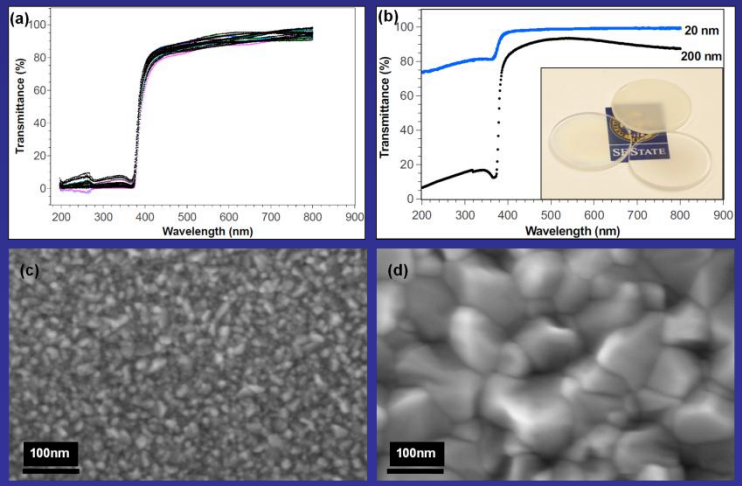
BACKGROUND: **Zinc oxide (ZnO), due to its large bandgap (3.37 eV) and its crystal lattice being noncentrosymmetric, is a unique energy material that exhibits dual semiconducting and piezoelectric properties. However, its use in energy generation remains limited as (1) little is known about how ZnO's energy conversion efficiency are influenced by its dimensional and mechanical properties, (2) deposition of high-quality, electrically conductive ZnO is time-consuming, often requires high-vacuum, elevated temperature and use of catalysts.**

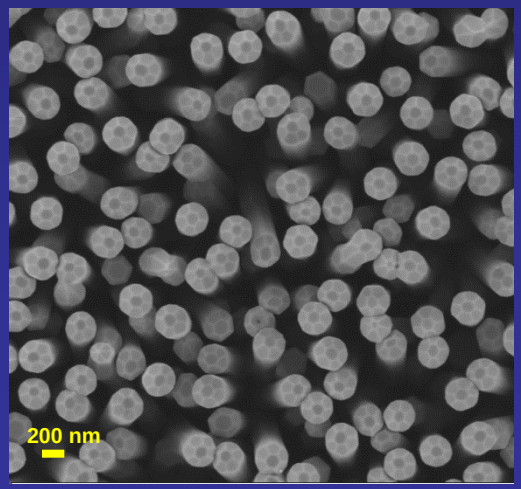


(a) ZnO Nanocrystalline Film on Si wafer, (b) Top view SEM, (c) Edge-on SEM of the same film. (Scale Bar = 100nm)

RESEARCH: **We have been researching the use of a rapid thermal plasma chemical vapor deposition (CVD) process as an energy- and time-efficient means to synthesize ZnO nanocrsytalline films and nanostructures. The two-phase process begins by melting the solid zinc precursor at 420°C with induction heating; the molten zinc is next bombarded by argon plasma, which produces ZnO on a collector surface. Our method localizes heating to a targeted, small thermal mass, thereby reducing synthesis time significantly (~ 2 orders of magnitude) compared to conventional furnace approach. Precise, close-looped control of plasma temperature, reacting gas partial pressures, substrate temperature and heating/cooling rates, we can produce conformal, non-porous ZnO nanocrystalline thin films and template-less, uniform-diameter ZnO nanowires with high repeatability.**



UV-Vis and SEM of ZnO Thin Films



Template-less, Aligned Nanowires