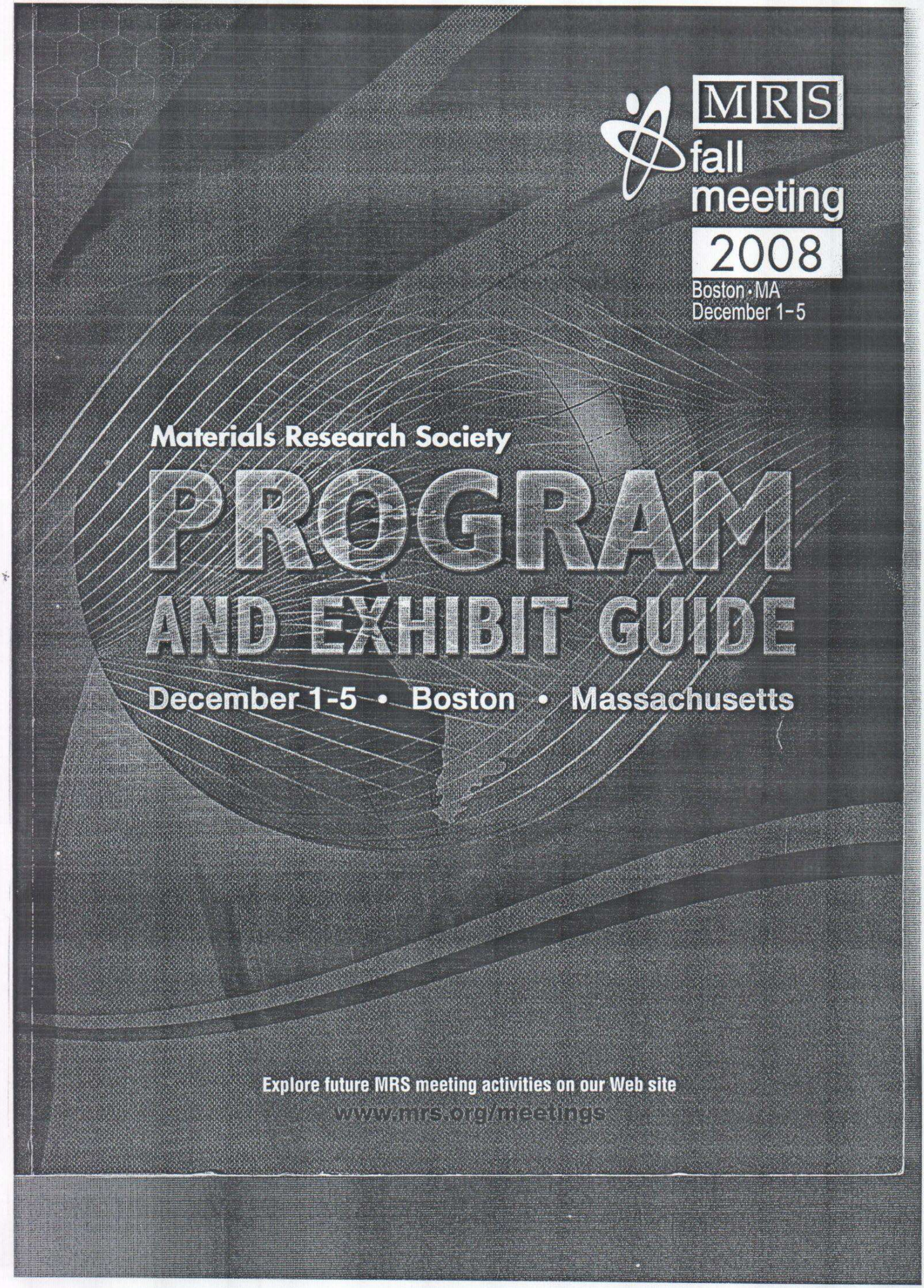
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ZnO is an attractive active semiconducting material for thin film transistor (TFT) applications due to its large band gap, high mobility, and good stability. In this study, a low-temperature processing from aqueous solution was developed for formation of thin crystalline ZnO films for TFTs that can be fabricated on flexible substrates. These solution based ZnO thin films exhibited a nanocrystalline structure with the electrical resistivity of ~10^{-2} ohm cm. It also revealed that the bulk precipitation and its clustering behavior in the solution would tailor the nano- and microstructure development and ultimately govern the performance of the ZnO films. Further, in an effort to correlate the structure-property relations, a variety of combinations of the precursor solutions and processing parameters were employed. In particular, the mobility and on/off ratio of the TFT devices fabricated from the ZnO films will be presented in this talk.

F6.23
High Yield Solution Synthesis of ZnO Nanowires and Films using a Microreactor. Kevin Michael McPeak and Jason B Baxter; Chemical & Biological Engineering, Drexel University, Philadelphia, Pennsylvania.

Chemical bath deposition (CBD) is an inexpensive, low temperature, aqueous method for depositing oxide and chalcogenide thin films and nanowire arrays. However, precipitation in solution competes with deposition on the substrate, frequently resulting in yields of less than 5% and excessive waste solvent. Here we report on a novel microreactor design where the substrate serves as one reactor wall and the chemical bath is contained within a sub-millimeter channel. This high surface-to-volume microreactor design eliminates mass transport limitations and reduces homogenous precipitation. Heating occurs through the back side of the substrate rather than throughout the chemical bath, with the resulting temperature drop across the bath slowing precipitation kinetics as well as deposition on the reactor walls. Furthermore, the low thermal mass of the microreactor allows for rapid heating, which reduces the induction time for nucleation. Tight process control and small transport length scales facilitate careful study of the thermodynamics and kinetics of deposition. In this paper, we will present results on microreactor solution deposition of ZnO thin films and nanowires. ZnO is a wide band gap semiconductor that has applications as a transparent conducting oxide, as well as in high frequency transparent electronics, emitters, sensors, photocatalysis, and nanostructured solar cells. ZnO was deposited from aqueous solutions of zinc nitrate and methanamine at 90 C. Nanowires were grown with 0.025 M concentrations of each precursor, while continuous films can be grown by doubling the concentrations. In each case, substrates were pre-seeded with a c-axis oriented, thin (< 40 nm), polycrystalline ZnO film by dip coating in zinc acetate solution and subsequently annealing in a humidity-controlled environment. Dense arrays of well-aligned single crystal nanowires with diameters of 80-100 nm and lengths of ~1 micron can be grown in a single batch deposition. Nanowires grew to ~250 nm in length within the initial 15 minutes of growth which is over four times longer than nanowires grown in a CBD reactor in the same amount of time. Deposition yields of 40-80% have been determined for nanowire growth by image analysis of SEM micrographs and by Inductive Coupled Plasma Mass Spectrometry (ICP-MS) of acid-digested nanowire arrays. These microreactor deposition yields are typically an order of magnitude higher than yields using CBD with the same chemistry. In addition to higher yield, nanowires grown in the microreactor show stronger UV band edge photoluminesence and less defect luminescence than CBD nanowires.

F6.24
Abstract Withdrawn

F6.25
Layer-by-layer Deposition of Utrathin Ceramic Films by Spin Coating. Edson R. Leite[1] and Caue Ribeiro[2]; [1]Chemistry, Federal University of Sao Carlos, Sao Carlos, Sao Paulo, Brazil; [2]EMBRAPA, Sao Carlos, Sao Paulo, Brazil.

This work describes the combined use of nanocrystal water-based colloidal dispersion with spin coating deposition in order to obtain ultrathin ceramic films. We have used tin oxide (SnO2) and antimony doped thin oxide (ATO) nanoparticles, with particle size ranging from 1nm to 6 nm, to develop the deposition approach. The films obtained in different deposition condition (solution concentration, speed rotation and deposition time) were characterized by elipsometry, electron microscopy (FE-SEM and TEM/HRTEM) and atomic force microscopy, showing that the process has the ability to produce ultrathin ceramic films, with thickness ranging from 10-100nm, with good particle packing. Additionally, electrical measurement in the films indicates good homogeneity and potential for various applications.

F6.26
Spin-spray Plated Ferrite Films with Controlling the Crystalline Orientation by Underlayers. Hajime Wagata[1], Masaru Tada[2], Masanori Abe[2], Masahiro Yoshimura[1] and Nobuhiro Matsushita[1]; [1]Electronic Chemistry, Tokyo Institute of Technology, Yokohama, Japan; [2]Physical Electronics, Tokyo Institute of Technology, Tokyo, Japan.

The spin-spray ferrite plating method enables us to deposit spinel ferrite films at very low temperature of 100 degree C just by spraying aqueous solutions to the substrate without post-deposition heat treatment. In spite of a low process temperature, the deposited films (the intermediate between Fe3O4 and γ-Fe2O3) are highly crystallized and exhibit saturation magnetization of 400-480 emu/cm3 as large as the bulk ferrite sintered at 1200 degree C, and coercivity of 20-100 Oe. Their real permeabilities of a few tens up to hundreds MHz is comparable to those of films prepared by the sputtering and the pulse-laser-deposition methods which require a high process temperature above 600 degree C. We reported that the spin-sprayed ferrite films would be applicable as the conducted noise suppressor on the printed circuit boards in the mobile computers and cellular phones utilizing their large magnetic loss in a several GHz range. These excellent properties are also attributed to the columnar structure of films, which are grown perpendicular to the substrate surface with a diameter of few hundred nanometers. In addition to the columnar structures, the crystallite orientation is also important for spinel ferrite films to control their magnetic properties. For example, (111)-orientated spinel ferrite films could exhibit high permeability due to a very small magnetic anisotropy field in film plane, since the first order of magnetic anisotropy constant K1 vanished. In this study, we investigated the control of crystallite orientation of ferrite films by using various kinds of under layers such as sputtered titan metal and nickel oxide underlayers, and solution-processed zinc oxide underlayer on glass substrates. The ferrite (the intermediate between Fe3O4 and γ-Fe2O3) film was prepared by spin-spray technique using a reaction solution containing 20 mM of FeCl2 and an oxidizing aqueous solution containing 65 mM of KCH3COO and 5.0 mM of KNO2. They were sprayed simultaneously at the supplying rate of 50 mL/min onto the substrates fixed on a turning table keeping the temperature at 90 degree C. The crystal structure and orientation were characterized by X-ray diffraction (XRD) and the morphology of the films was observed by scanning