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Fired Crystalline Oxide Thin films on Plastic Substrates: Fabrication via Sol-Gel and Transfer Processes

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Our group has recently proposed a new technique for realizing crystalline oxide thin films on plastic substrates [1-3]. The technique is based on the sol-gel thin film deposition and the transfer process (Fig. 1), i.e. it comprises (i) deposition of a polymer layer on a silicon substrate, (ii) deposition of a precursor gel film on the polymer layer by spin- or dip-coating, (iii) conversion of the gel film into a crystalline oxide film by firing, and (iv) transfer of the crystalline oxide film onto a plastic substrate. The transfer is realized by heating the oxide film on a hot plate and pressing the plastic substrate onto it where the softened or molten surface of the plastic substrate acts as an adhesive. The technique is significant in that the "firing" step guarantees the crystallization and densification of films, which are the key factors for their superior functionalities, and that the principle of the technique is available for any combinations of oxide thin films and plastic substrates.

The crystalline oxide thin films thus fabricated on plastic substrates are crack-free and optically transparent, and have smooth surface [1,2]. 60 nm thick anatase thin films with high optical reflectivity (Fig. 2 (a)), 660 nm thick ITO thin films with electrical conductivity (Fig. 2 (b)), and 85 nm thick ZnO thin films with (002) orientation have been prepared on plastic substrates including polycarbonate, acrylic resin and PET. Patterned ITO thin films have been prepared on plastics simply by using a mother silicon substrate with periodic grooves (Fig. 2 (c)). Alternating ITO and ZnO ribbons have also been fabricated on plastic substrates [3]. The factors that affect the transfer performance, the adhesion and the bendability will also be addressed.

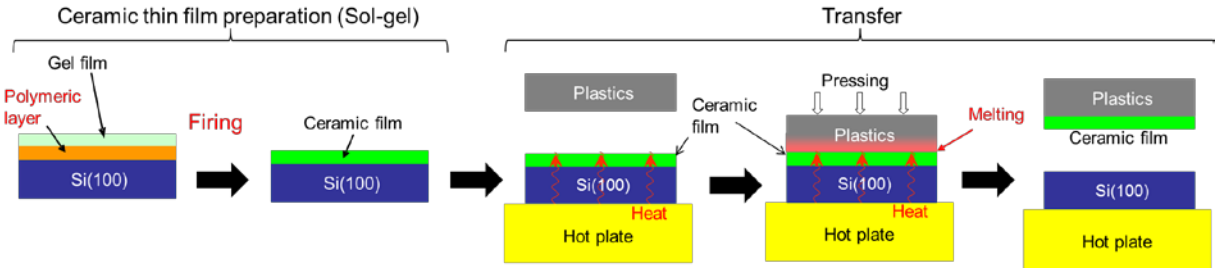

Fig. 1 Technique for preparing fired crystalline oxide thin films on plastic substrates.

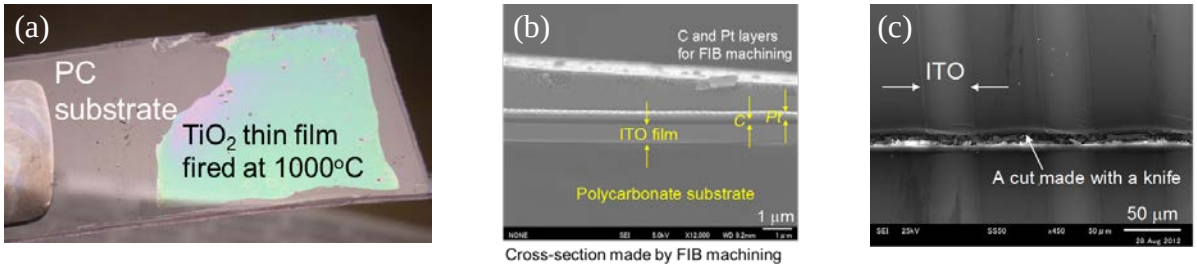

Fig. 2 (a) TiO_2 thin film, (b) ITO thin film and (c) ITO ribbons on polycarbonate substrates prepared by sol-gel and transfer technique.

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2. H. Kozuka, *J. Mater. Res.*, **28**, 673 (2013).
3. H. Kozuka, T. Fukui and H. Uchiyama, *J. Sol-Gel Sci. Techn.*, **67**, 414 (2013).