Dielectric/metal/dielectric alternative transparent electrode: observations on stability/degradation

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Mots-clés	ageing effect [12], dielectric–metal–dielectric structure [13], metal diffusion [14], transparent electrode [15]
Résumé en anglais	The use of indium-free transparent conductive electrodes is of great interest for organic optoelectronic devices. Among the possible replacements for ITO, dielectric/metal/dielectric (D/M/D) multilayer structures have already proven to be quite efficient. One issue with organic devices is their lifetime, which depends not only on the organic molecules used but also on the electrodes. Therefore we study the variation, with elapsed time, of the electrical and optical properties of different D/M/D structures, with M = Ag or Cu/Ag. Six years after realization, it has been shown that if some structures retained an acceptable conductivity, some others became non-conductive. For a sample which remains conductive, in the case of a PET/MoO3/Ag/MoO3 multilayer structure, the sheet resistance changes from 5 Ω/sq–17 Ω/sq after six years. This evolution can be compared to that of a PET/ITO electrode that varies from 25 Ω/sq–900 Ω/sq after six years. It means that not only are the PET/MoO3/Ag/MoO3 multilayer structures more flexible than PET/ITO, but they can also be more stable. Nevertheless, if some PET/MoO3/Ag/MoO3 multilayer structures are quite stable, some others are not. This possible degradation appears to be caused primarily by the physical agglomeration of Ag, which can result in Ag film disruption. This Ag diffusion seems to be caused by humidity-induced degradation in these Ag-based D/M/D structures. Initially, defects begin to grow at a 'nucleus', usually a microscopic particle (or pinhole, etc), and then they spread radially outward to form a nearly circular pattern. For a critical density of such defects, the structure becomes non-conductive. Moreover the effect of humidity promotes Ag electrochemical reactions that produce Ag+ ions and enhances surface diffusivity with AgCl formation.

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