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Effects of Mg content and annealing treatment on optical and electrical properties of CuMg and ITO/CuMg metallic glass films

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Abstract

CuMg (CM) and ITO/CuMg (ICM) films with Mg contents ranging from 30~65 at% are deposited on glass substrates and are then treated by furnace annealing and laser annealing. The structural, optical and electrical properties of the as-deposited and annealed samples are investigated and compared. It is shown that as the Mg content increases, the sheet resistance of the CM film increases, while the transmittance decreases. For a Mg content of 49 at%, the bi-layer ITO/CM structure improves the transmittance from 62.6% (CM) to 75.6% (ICM) and reduces the resistance from 51.3 Ω/□ (CM) to 49.5 Ω/□ (ICM). Moreover, following furnace annealing at 200^{o}C, the transmittance of the ICM sample is further improved to 78.5% while the sheet resistance is reduced to 32.4 Ω/□. The corresponding figure of merit is equal to 2.74×10^{-3} Ω^{-1}, and is thus similar to that of commercial ITO film (2.68×10^{-3} Ω^{-1}). The optimal laser annealing parameters for the $Cu_{51}Mg_{49}$ ICM sample are found to be a pulse energy of 1 μJ and a repetition rate of 250 kHz. Given the use of these parameters, the ICM film has a transmittance of 77.5% and a sheet resistance of 26.5 Ω/□. The corresponding figure of merit has a value of 2.94×10^{-3} Ω^{-1}. Finally, the relative change in resistivity of the as-deposited $Cu_{43}Mg_{57}$ ICM sample following fatigue testing with a