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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/\square (CM) to 49.5 Ω/\square (ICM). Moreover, following furnace annealing at 200°C, the transmittance of the ICM sample is further improved to 78.5% while the sheet resistance is reduced to 32.4 Ω/\square . The corresponding figure of merit is equal to $2.74 \times 10^{-3} \Omega^{-1}$, and is thus similar to that of commercial ITO film ($2.68 \times 10^{-3} \Omega^{-1}$). The optimal laser annealing parameters for the Cu₅₁Mg₄₉ 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/\square . The corresponding figure of merit has a value of $2.94 \times 10^{-3} \Omega^{-1}$. Finally, the relative change in resistivity of the as-deposited Cu₄₃Mg₅₇ ICM sample following fatigue testing with a

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