STRUCTURAL AND OPTICAL PROPERTIES OF THERMOCHROMIC $V_{1-x}RE_xO_2$ THIN FILMS OBTAINED BY DC MAGNETRON SPUTTERING

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Vanadium dioxide (VO_2) is a unique material which shows a reversible metal–insulator phase transition (MIT) near t_{MIT} = 68 °C [1]. During the phase transition, an ultrafast rearrangement of the electronic spectrum occurs. This leads to serious changes in the electrical and optical properties of VO_2. These striking properties make the material highly interesting for applications in smart coatings, electronic switches etc [2]. However, there are challenges that prevent the application of VO_2-based materials in smart windows. In particular, the t_{MIT} should be decreased to a value close to room temperature, while the light transmission and solar energy modulation ability should be sufficiently high. In order to solve these problems, we synthesized $V_{1-x}Re_xO_2$ ($0.01 \leq x \leq 0.50$) thin films on quartz substrates by DC magnetron sputtering in Ar atmosphere followed by their oxidation. The doping of VO_2 with rhenium is of particular interest because Re can adopt valence states between +4 and +7 in the octahedral oxygen surrounding. So, it provides electron injection and deformation of the crystal lattice and thus plays an important role in decreasing of t_{MIT}. However, there are very few works [3] devoted to the synthesis of $V_{1-x}Re_xO_2$ crystals, and to the best of our knowledge no works on thermochromic $V_{1-x}Re_xO_2$ films.

The $V_{1-x}Re_xO_2$ films were characterized by XRD, XPS, and temperature dependence of the transmittance/reflectance optical spectra. Temperature dependent optical transmittance/reflectance measurements reveal switching efficiency for $V_{1-x}Re_xO_2$ films. Re-doped VO_2 composite film that was prepared with Re 1.0-8.0 at.% showed relatively low transition temperature (about 30 ˚C) and good NIR switching efficiency (till 25.0 %).

References

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