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Electrochemical and structural characterization of BITAVOX.20 thin films.Eloi Dereeper¹, Pascal Briois¹, Rose-Noëlle Vannier², Alain Billard¹¹LERMPS-UTBM, Belfort, France ²LCPS, UMR CNRS 8012, ENSCL, Villeneuve d'Ascq Cedex, France

eloi.dereeper@utbm.fr

The BIMEVOX.100x are a family of solid electrolytes of general formula $\text{Bi}_2\text{Me}_x\text{V}_{1-x}\text{O}_{5.5-6}$ whose ionic conductivity is the highest known among the O^{2-} solid state conductors at intermediate temperatures (400 – 600°C). They derive from the $\text{Bi}_4\text{V}_2\text{O}_{11}$ parent compound, which high temperature polymorph γ has been stabilized by partially substituting vanadium by either aliovalent ions (Cu^{II} , CO^{II} ...) or isovalent ions (Ta^{V} , Nb^{V} , etc...). The first ones permit to reach the highest conductivity levels, with about $10^{-1} \Omega^{-1} \cdot \text{cm}^{-1}$ at 600°C. However, they are likely to transform into a less conductive α -related phase after several hundred hours long thermal treatment at 450°C. The second ones exhibit slightly lower conduction performances, but are more thermally stable. Moreover, all these materials are quite reducible and must therefore be used for oxygen-rich atmosphere applications only. The BITAVOX.20 films characterized here are deposited by reactive magnetron co-sputtering of bismuth, tantalum and vanadium targets under Ar and O_2 reactive atmospheres. In order to avoid its evaporation, the intensity imposed to the bismuth target is limited to 0.1 A. Then, the sputtering conditions of the two other metal targets are varied and their chemical and structural features are assessed by means of EDS and X-ray diffraction, respectively. Since the as-deposited films are amorphous, their crystallization is also assessed thanks to X-ray diffraction in temperature. Finally, attention is paid to the influence of total pressure as well as films thickness: their consequences on the microstructure are observed by SEM, and electrochemical impedance spectroscopy measurements are performed to determine the evolution of the electrical properties with these parameters.

Keywords

reactive magnetron sputtering

BITAVOX.20

X-Ray Diffraction

Ionic conductivity