Synthesis of Metal Oxycarbides Hard Films by Plasma Assisted Sputtering

- New hard coating method using carbon dioxide, methane and metal -

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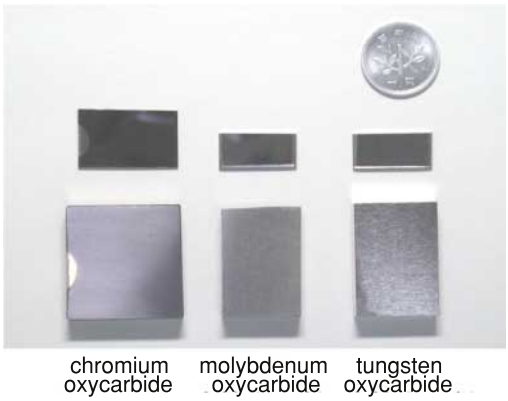
It has been well known that metal hexacarbonyl can be prepared by chemical vapor deposition to give a range of oxycarbide which shows high hardness and high anti-corrosive properties.

Recently, instead of the decomposition of metal organic sources by the chemical vapor deposition, there has been a growing interest in synthesis by reactive physical vapor deposition because of the operation without use of metal organic toxic sources. We have synthesized chromium oxycarbide and molybdenum oxycarbide films from metals and carbon dioxide without metal hexacarbonyl by the inductively coupled rf plasma assisted magnetron sputtering method. But cubic tungsten oxycarbide with high hardness has not been synthesized well by the method. In order to increase activated molecules of carbon dioxide in the plasma and to promote the reaction of tungsten atoms with carbon dioxide in reactive sputtering, a mixture of Ar, He, CO_2 and CH_4 was used as sputtering gas for the sputtering method, and tungsten oxycarbide films were synthesized with metal and carbon dioxide by this method. In near future, the metal oxycarbides are expected to be used widly as hard coating materials.



Chromium oxycarbide, molybdenum oxycarbide and tungsten oxycarbide synthesized on stainless steel substrates (upper side) and aluminum alloy substrates (lower side) by inductively coupled rf plasma assisted magnetron sputtering. The micro-Vickers hardness of the films is more than 21GPa. [The diameter of a coin is 20 mm.]

Standards and Measurement Technology

Measurement of Frequency Dependence of Fused-Silica Standard Capacitor

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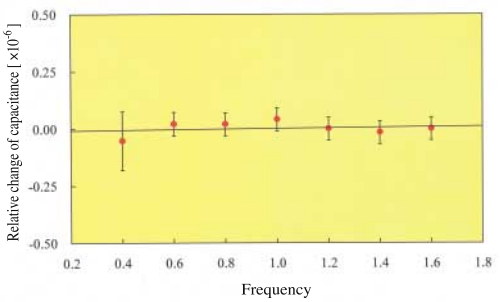
The frequency dependences of fused-silica standard capacitors have been measured precisely. The capacitors used in the measurements are commercially available. The results have shown that their capacitances are frequency independent in the range between 0.4 kHz and 1.6 kHz.



Frequency dependence of a fused-silica standard capacitor.