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The effect of hydrogen on the crystallization of MoC1-x at low temperatures by the plasma enhanced chemical vapor deposition using bis(tert-butylimido) bis(dimethylamido) molybdenum

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The complex composites of molybdenum carbide and amorphous diamond like carbon were deposited at temperatures ranging under 200 °C and pressure of 4 Pa by the plasma enhanced chemical vapor deposition using bis(tert-butylimido) bis(dimethylamido) molybdenum with hydrogen, and nitrogen. As well as argon was carrier gas to delivery of liquid metal organic precursors at temperature of 80 °C. For plasma generation in process, pulsed DC plasma used at negative voltage of -600 V with frequency of 150 kHz, and pulse reversal time as 1 μs. The chemical binding states of molybdenum contained complex composites were analyzed by the x-ray photoelectron spectroscopy and the Raman spectroscopy. The x-ray diffraction were obtained to determine the crystallography on the MoC_{1-x} composite. In condition of only using argon carrier gas, films were strongly deposited by amorphous diamond like carbon with a high hardness as 23 GPa and consisted small amount of cubic structured α-MoC_{1-x}. However, introducing the hydrogen gas in deposition process, the α-MoC_{1-x} composite was preferred growth, whereas composition ratios of amorphous diamond like carbon composite was reduced. To molybdenum carbide formation was recrystallization of molybdenum composites by the dissociation from molybdenum to nitrogen contained organic groups bonds in bis(tert-butylimido) bis(dimethylamido) molybdenum. The hydrogen as reactive gas play a role of catalyst for formation of molybdenum carbide at low temperatures. The α-MoC_{1-x} phase rich films showed hardness as 20 GPa, well adhesion over 30 N (HF1) in plasma enhanced chemical vapor deposition process.

Keywords
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