Thermal decomposition of $Ru(EtCp)_2$ and metallorganic chemical vapor deposition of Ruthenium thin films using $Ru(EtCp)_2$

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The metallic ruthenium films were prepared by metalorganic chemical vapor deposition using Ru(EtCp)2 precursor in various atmosphere. The thermal decomposition behavior of $Ru(EtCp)_2$ was studied using thermogravimetry and infrared and mass spectroscopy. Particularly, the dissociation of the chemical bonds in the complex ligand was monitored from the IR spectra of the complex under $O_2$ and Ar atmosphere while the sample was heated. The chemical bonds in the complex ligand were dissociated sequentially at elevated temperatures. Ambient gases significantly had an effect on the IR patterns of the complex. Oxygen gas influenced decreasing dissociation temperature of chemical bonds in the complex. The bond between Ru and EtCp ligand was dissociated more easily than the C-H bond did and the C-C bond under $O_2$ atmosphere. However C-H and Ru-EtCp bond were dissociated at similar temperature under Ar. Although a sufficient amount of oxygen gas is required for thermal decomposition of $Ru(EtCp)_2$ at low temperature, Ru metal was deposited without any detectable $RuO_2$ impurity. There was optimum oxygen-to-precursor ratio for the pure Ru phase. As the oxygen-to-precursor ratio was increased, the step coverage was improved due to the decrease of sticking coefficient. The increase of deposition temperature caused the improvement of electrical property and the decrease of step coverage. Two step process was investigated to improve the electrical property and the step coverage of Ru films.. Ru film deposited using two step process have 15μΩ-cm and 80%, step coverage.

The O-Ti-O bond is stabole up to allow the ligand ring to pen reduce the steric hindrance by the lignads, which eventually leads to the oligmerizatin of the complex.

The complex oligmerized at 110 as confirmed by mass spectroscopy

the absolute composition and electrical properties were investigated

Ru(EtCp)2 is relatively stable, shows no weight loss at 150, and degrades only slightly after storag for a year. The thermogravimetric patterns of the complex is unaffected by ambient gases

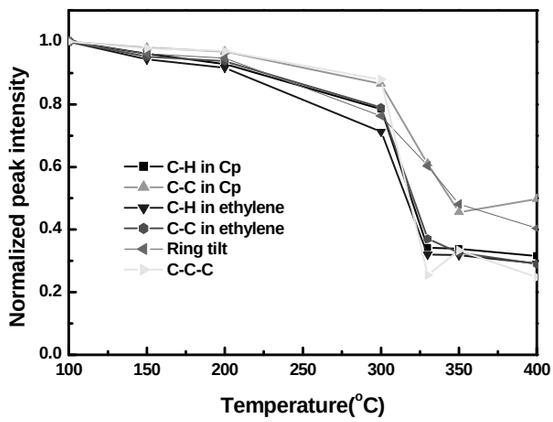


Fig. 1 (a). Change in the normalized intensity of the IR peaks under Ar

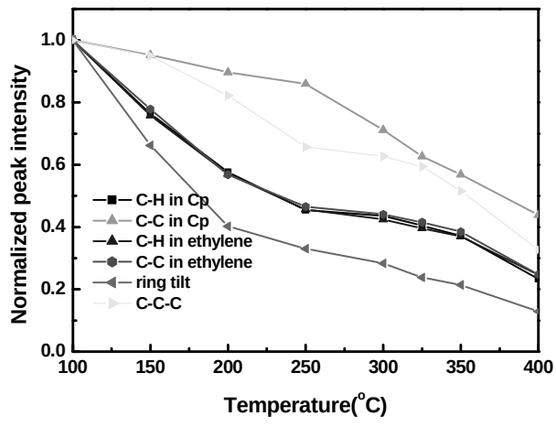


Fig. 1 (b). Change in the normalized intensity of the IR peaks under $O_2$

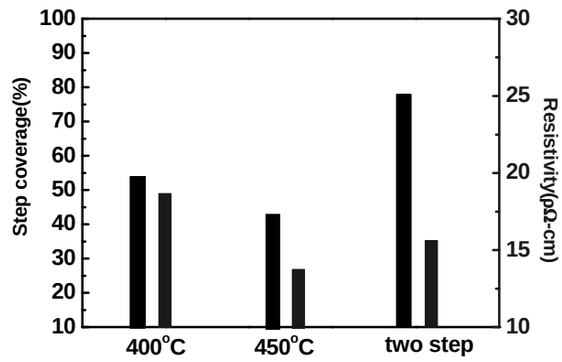


Fig. 2. Step coverage ad electrical property of Ru films deposited under different conditions