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Author: Mr. Dawei Han
Aerospace Research Institute of Materials and Processing Technology(ARIMP), China

Dr. Hu Honglin
China
Prof. Ruilian Yu
China
Prof. Zhihai Feng
China

THE SYNTHESIS AND PYROLYSIS MECHANISM OF RESOLE PHENOLIC RESIN FOR ABLATIVE MATERIALS

Abstract

Phenol-formaldehyde-based composites were widely applied in ablative materials because of their flame retardant heat resistance, outstanding thermal stabilization and high-temperature mechanical performance. The pyrolysis reaction converts the resin matrix to amorphous carbon, and releases many gaseous products at the same time. It is an important issue to understand decomposition process of matrix by investigating pyrolysis mechanism of phenolic resin including the evolvement of chemical structure and physical structure. Therefore, in this paper, resole phenolic resins were synthesized, and pyrolysis mechanism were systematically investigated. The resultant resins were disposed at different temperature on the condition of inert gases. Fourier transform infrared spectroscopy (FTIR) was applied to characterize the resin residue, and pyrolysis gas chromatographymass spectrometry (PGC-MS) is utilized to examine the volatiles. Thermogravimetric mass spectrometry (TG-MS) was used to analyze species of gas production with increase of temperature. SEM was applied to observe the change of surface morphology of disposed resins. In conclusion, pyrolysis mechanism of resole phenolic resin for ablative materials was deduced. The main conclusion can be summed as follows: (1)At the beginning, deep crosslinking reaction between phenolic hydroxyl and methylene occurs, releasing water; (2) As increase of temperature, the end of molecular of phenolic resin is firstly decomposed, releasing phenol; (3) Subsequently, polymer chain backbone is ruptured, and releases benzene and its orthologs, phenol and its orthologs; (4) The resultant water as oxidant can react with methylene, forming carbonyl group. Decomposition of carbonyl group results in the formation of carbon dioxide and carbon monoxide.