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木质陶瓷的X射线衍射和喇曼光谱研究

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摘要 采用X射线衍射和激光喇曼光谱,
研究了以烟杆和酚醛树脂为原料制备木质陶瓷炭化过程中结构的变化特征. 研究结果表明,
炭化温度的升高可以使木质陶瓷XRD谱图中衍射峰增加, 强度增大, 同时木质陶瓷中石墨微晶的平均层间距d_{002}减小, 堆积厚度L_c增加, 微晶直径 L_a在973K出现转折点;
木质陶瓷的喇曼光谱图为典型的类石墨炭材料的喇曼谱图, 只出现了表征无序结构的D线和表征石墨结构的G线, 且表征无序化度的二者积分强度比R值随炭化温度的升高先增后减, 而根据Tuinstra-Koenig
经验式计算得到的微晶直径L_a值表现出与R值相反的规律; 两种分析方法的结果较为一致,
均表明木质陶瓷结构在973K发生根本改变, 说明喇曼光谱有望成为木质陶瓷结构的快速测试方法.

关键词 木质陶瓷 结构 X射线衍射 喇曼光谱

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Structure Evolution of Woodceramics by X-ray Diffraction and Raman Spectroscopy

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Abstract The laser Raman spectroscopy and X-ray diffraction (XRD) techniques were applied to investigate the structure of woodceramics (WCS) from carbonizing tobacco stems and phenolic resin at different carbonization temperatures up to 1773K. Experimental results show WCS are non-graphitic carbon consisting of tobacco stems-originated amorphous carbon reinforced by glass-like carbon generated from phenolic resin. With the increase of carbonization temperature, the number of diffraction peaks is increasing, but the interlayer spacing of graphene sheets, d002, is decreasing. As carbonization temperature increased above 973K, the turbostratic crystallites grew very little, but the graphene sheets grew substantially from 2.7 to 5.6nm by Scherrer equation. The Raman spectra of WCS show the known D band which is related to disorder carbon and G band which corresponds to graphite with varying characteristics that are similar to other graphitoidal materials. The integrated intensity ratio R=I D/I G(R-value) which is the degree of disorder of WCS is decreasing with the increase of carbonization temperature above 973K. And the trend of L a calculated by using the Tuinstra-Koening empirical relation is opposite but is consistent by Scherrer equation of XRD technique. The obtained results also indicate that 973K is the turning point temperature for preparation of WCS and the Raman spectroscopy will become a quick method for the structure analysis of WCS.

Key words woodceramics structure X-ray diffraction Raman spectroscopy

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