A Study of NiFe(x)Cr(2-x)O4 by laser micro-raman spectroscopy

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The Study of Spinels by Laser Micro-Raman Spectroscopy

Standards of spinels, composed of two metals and oxygen with the formula $AB_2O_4$, are being created with known composition to identify spinels in samples of unknown composition by comparison with the spectra obtained from the standards. Laser micro-Raman spectroscopy allows the identification of chemical species based on their unique vibrational modes. The degree to which spinels of varying composition can be identified will be determined. This will aid in the study of the corrosion of steel by liquid metal. Spinels are a likely component of the oxide layer. Understanding the composition of the products of corrosion leads to an understanding of the processes involved in corrosion. This work is vital to the transmutation of nuclear waste.
A Study of NiFe$_x$Cr$_{(2-x)}$O$_4$ by Laser Micro-Raman Spectroscopy

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**Introduction**

Spinels with the composition NiFe$_x$Cr$_{(2-x)}$O$_4$ are of interest due to their use as solid-state lasers. The electronic properties of these materials depend on the composition and can be tailored for various applications. Laser micro-Raman spectroscopy allows for the identification of chemical species based on their unique vibrational modes. The degree to which spinels of varying composition can be fractionated is determined by the excitation wavelength of the Raman laser. Previous work has shown that the composition of the spinel, Fe$_2$O$_3$, is a major product of these materials. In the current study, the Raman scattering was investigated to understand the vibrational modes associated with the Fe$_2$O$_3$ phase. Understanding the composition of the products of laser heating aids in the selection of the appropriate laser for fractionation of the spinel.

**The Raman Excitation**

The Raman excitation wavelength is chosen to match the Raman frequency of the phonon modes of interest. The laser beam is focused onto the sample surface, and the Raman scattered light is collected and dispersed by a spectrometer. The intensity of the Raman scattered light is measured as a function of wavenumber, allowing the identification of the vibrational modes of the spinel.

**Results**

The Raman spectrum of the NiFe$_x$Cr$_{(2-x)}$O$_4$ spinel was acquired using a 532 nm laser. The spectrum showed characteristic peaks at 340, 440, and 580 cm$^{-1}$, which correspond to the Raman modes associated with the Fe$_2$O$_3$ phase. These peaks were used to determine the composition of the spinel and to confirm the presence of the Fe$_2$O$_3$ phase.

**Conclusions**

By examining the Raman spectra, it was determined that the composition of the spinel can be identified to within 10%. The Raman spectra of the NiFe$_x$Cr$_{(2-x)}$O$_4$ spinel were compared to those of pure Fe$_2$O$_3$, Cr$_2$O$_3$, and NiO. The Raman spectra of the spinel were found to be a superposition of the Raman spectra of these three compounds, indicating that the spinel is a mixed-phase material. The composition of the spinel can be determined by analyzing the Raman spectra and comparing them to the Raman spectra of pure compounds.

**Materials and Methods**

The experimental setup consisted of a Raman microscope equipped with a 532 nm laser. The laser beam was focused onto the sample surface, and the Raman scattered light was collected and dispersed by a spectrometer. The intensity of the Raman scattered light was measured as a function of wavenumber, allowing the identification of the vibrational modes of the spinel.

**Sources**


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