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# Tracking intra-molecular electron and vibrational energy redistribution by time and frequency resolved transient grating spectroscopy

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## Abstract

Theoretical calculation results show that electron flow occurs from xanthene to the phenyl ring within the Rh101<sup>+</sup> after its electronic transition from ground state ( $S_0$ ) to first excited state ( $S_1$ ). Time and frequency resolved transient grating (TG) spectroscopy is then conducted to seek the experimental evidence. Through Fourier analysis at different wavelengths of TG signal and their specific value spectra, vibrational enhancement corresponding to electron acceptor chromophore (phenyl ring) is observed. So the ultrafast vibrational energy redistribution process is detected experimentally and the direction of electron flow is confirmed.

**Keywords:** transient grating, electron redistribution, vibrational energy redistribution, electron-vibration coupling

## 1. Introduction

The electron redistribution within the molecule and vibrational energy redistribution [1-3] are the most frequently processes in the primary biological and photochemical reactions [4,5]. These processes play fundamental roles in micro level. Tracking electron redistribution and vibrational energy redistribution after electronic transition can offer important insights to design and manufacture molecular devices.

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