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研究期間：2016～2018

課題番号：16K05644

研究課題名(和文)ルミネッセンス分光法による高分子の熱酸化劣化・放射線劣化の機構の解明

研究課題名(英文)Elucidation of degradation mechanism of polymers in thermal oxidation and gamma-ray irradiation by luminescence spectroscopy

研究代表者

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研究成果の概要(和文)：マルチチャンネルフーリエ変換型微弱発光分光分析装置で、有機高分子や無機高分子を加熱した際に発する極微弱なルミネッセンスをスペクトルとして測定した。マトリックス単離赤外分光法、紫外可視分光法、熱分析法などの併用解析によって、(1)ポリテトラフルオロエチレンの放射線劣化による過酸化ラジカル生成機構の解明、(2)エラストマーの生成に用いられる架橋剤の熱酸化劣化機構の解明、(3)ルミネッセンス分光法の放射線照射履歴の検知法としての可能性の検討を行った。

研究成果の学術的意義や社会的意義

新しく開発された発光分光分析装置で、物質から放射される極微弱な光を検出した。この装置の特色は発光の強度だけでなく、発光の種類も区別できることである。とくに、放射線を照射した有機高分子(ポリエチレンなど)や、無機高分子(カキやホタテなどの貝殻)からの発光を丁寧に分析して、どのくらいの放射線が照射されたかを調べた。前処理することのない簡易な放射線量の測定法を提案した。

研究成果の概要(英文)：Ultraweak chemiluminescence from organic and inorganic polymers during heating was measured as spectrum with a multichannel Fourier-transform chemiluminescence spectrometer. By joint use of matrix-isolation infrared spectroscopy, UV-visible spectroscopy, and thermal analysis, the following research projects were performed: (1) Elucidation of gamma-ray irradiation degradation mechanism of polytetrafluoroethylene to produce peroxy radical; (2) elucidation of thermal oxidative degradation mechanism of cross-linking agents to be used in production of elastomers; (3) consideration of possibility of a detection method of gamma-ray irradiation history by thermoluminescence spectroscopy.

研究分野：物理化学

キーワード：ルミネッセンス分光法 熱酸化劣化 放射線劣化 放射線履歴検知

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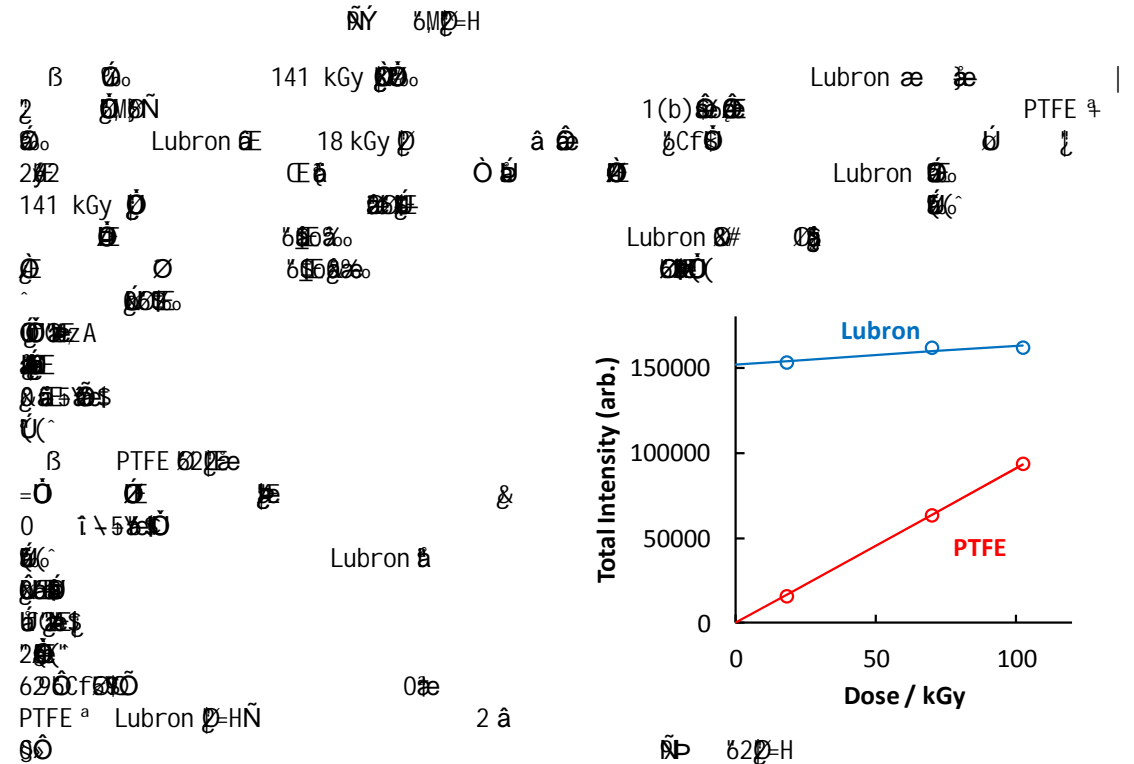
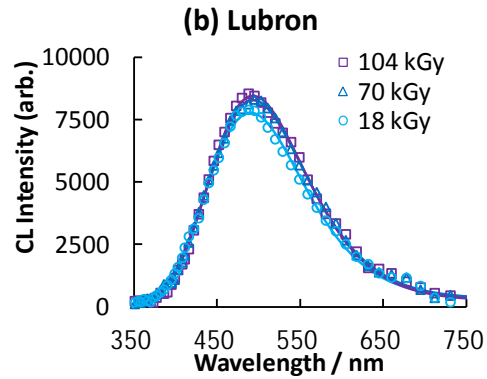
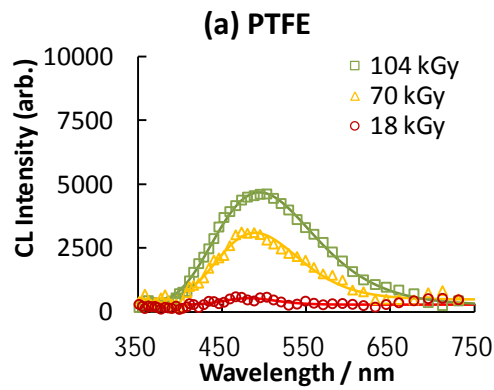
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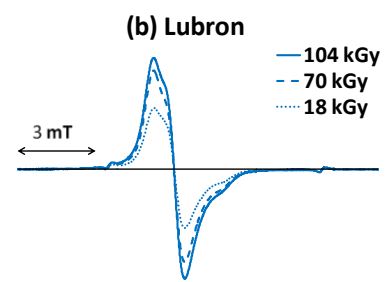
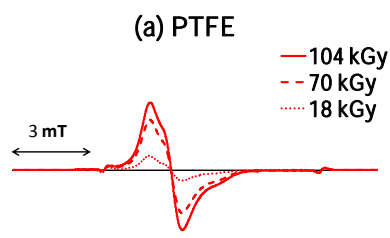
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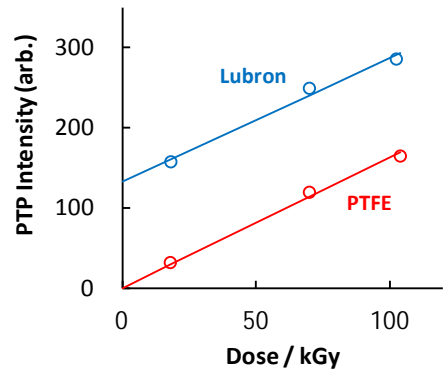
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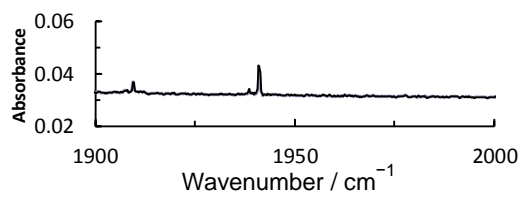
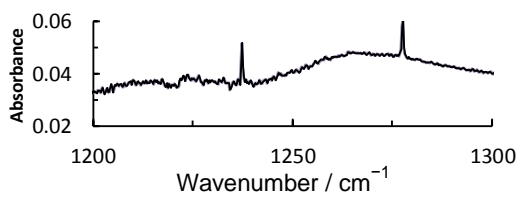
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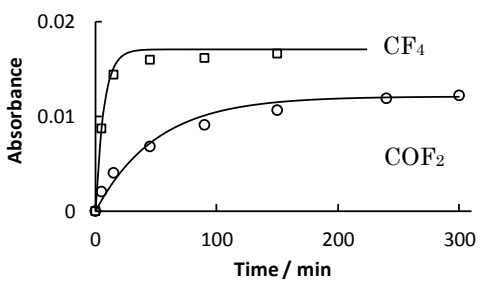
peak-to-peak
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 1941 1910 cm⁻¹ COF₂ C=O 1278 cm⁻¹ CF₄ C-F 1237 cm⁻¹ COF₂
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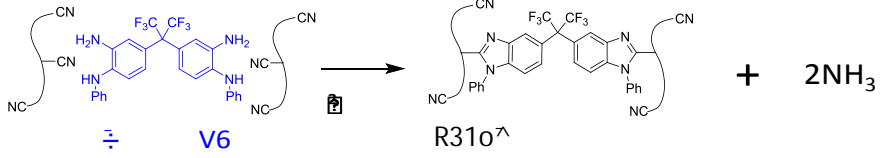
COF₂^a CF₄
 CF₄ CE COF₂^y
 0.145(23) min³¹ COF₂
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 CF₄ PTFE



$\text{COF}_2 \text{ } \text{BF}_2$ 0.02 min^{-1} 0.72
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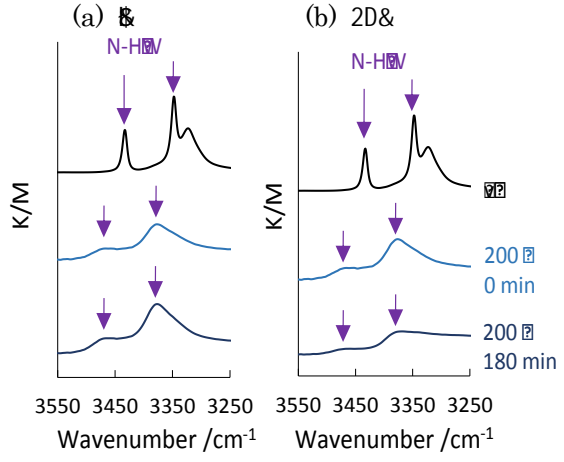
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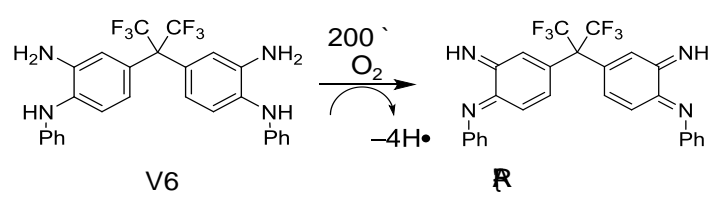


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579 nm 539 nm
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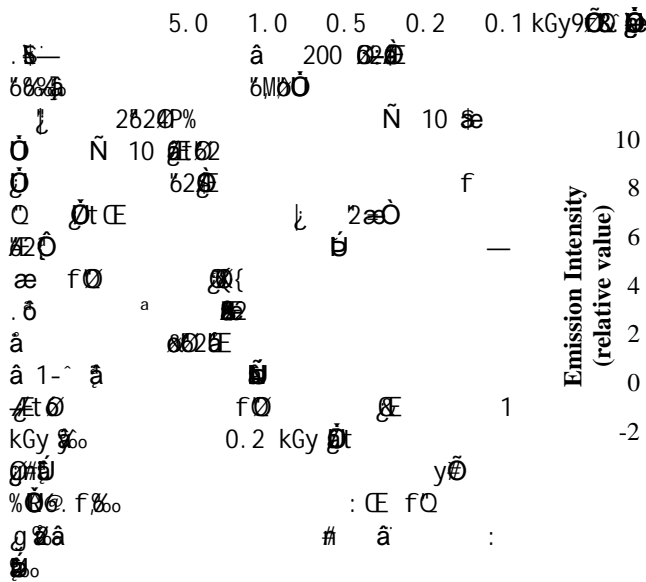


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Relationship between crystal structures and thermoluminescence spectra of gamma-irradiated shells of shellfishes measured with a multichannel Fourier-transform luminescence spectrometer *Bull. Chem. Soc. Jpn.* 0. > vol 90 No 9 2017 905-909
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