



### 材料合成及性能

#### CaS:Eu,Sm 荧光粉表面二氧化硅包覆对其光激励发光特性的影响

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**摘要：** 改进了CaS:Eu,Sm 荧光粉在实时剂量计系统中的稳定性和实用性。以不同体积的正硅酸乙酯作为前驱体,采用溶胶凝胶法对CaS:Eu,Sm 荧光粉进行表面包覆。分别使用荧光分光光度计和酸度计对荧光粉的发光特性和防水特性进行表征。实验结果显示当质量分数为5%时, 包覆层能明显提高荧光粉的稳定性且不影响荧光粉的发光强度。从材料的光激励发光和剂量响应测试实验中可以得到材料的退火特性以及相应的辐射剂量值。以CaS:Eu,Sm 荧光粉为基础的辐射剂量测试系统显示在0.1~300 Gy范围内具有良好的线性关系。结果显示表面包覆层明显抑制光激励发光特性,而且随着辐射剂量的增加,这种影响愈来愈显著。最后,我们提出了以光激励发光技术为基础的辐射剂量在线测试改进系统。

**关键词：** CaS:Eu,Sm 光激励发光 二氧化硅包覆 溶胶凝胶法

#### Effects of Silica-encapsulated CaS:Eu,Sm Phosphors on Optically Stimulated Luminescence Properties

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**Abstract:** The objective of this work was to improve the stability and reproducibility of CaS:Eu,Sm phosphors in a real-time dosimetry system. Different volumes of tetraethyl orthosilicate, were used as precursor and coated onto CaS:Eu,Sm phosphors by the sol-gel method. The luminescence properties and water resistance of the phosphors were evaluated using a fluorescence spectrometer and an acidometer respectively. The results show that 5%(mass fraction)of silica coating effectively improve their water resistance with minimum loss of light emission. The optically stimulated luminescence (OSL) decay and dose response of coated CaS:Eu,Sm phosphors offer an easy evaluation of the annealing time and specify dose. The dose characteristic is linear from 0.1 to 300 Gy. The 5% SiO<sub>2</sub>-coated CaS:Eu,Sm phosphors' variation of the reusability is below 2% at dose of 1 Gy. The amount of surface coating significantly affected the OSL signal, which became more pronounced with the increasing radiation dose. A novel dosimetry system based on the OSL technique is proposed for real-time measurement.

**Keywords:** CaS:Eu,Sm OSL silica encapsulation sol-gel

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#### 参考文献:

- [1] Rao,R., J. Gasiot,Optically stimulated luminescence dosimetry,Radiation Protection Dosimetry,1983. 6(1-4): 64-66[J]...():-
- [2] Kravets,V.G.,Using electron trapping materials for optical memory,Optical Materials,2001. 16(3): 369-375 [J]...():-
- [3] Lapraz,D.,H. Prévost,K. Idri,et al.,On the PL,TSL and OSL properties of SrS: Ce,Sm phosphor,physica status solidi (a),2006. 203(15): 3793-3800[J]...():-
- [4] Yanping,Li.U.C. Zhaoyang,B.A. Weizhen,et al.,Optically stimulated luminescence dosimeter based on CaS:Eu,Sm,Nuclear Science and Techniques,2008. 19(2): 113-116[J]...():st
- [5] Guo,C.,D. Huang,Q. Su,Methods to improve the fluorescence intensity of CaS: Eu2+ red-emitting phosphor for white LED,Materials Science and Engineering: B,2006. 130(1): 189-193[J]...v
- [6] Hasan,Z.,M. Solonenko,P.I. Macfarlane,et al.,Persistent high density spectral holeburning in CaS:Eu and CaS:Eu,Sm phosphors,Applied Physics Letters,1998. 72(19): 2373-2375[J]...volum

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13. Li<sup>+</sup>离子掺杂Gd<sub>2</sub>O<sub>3</sub> : Sm<sup>3+</sup>纳米晶的发光[J]. 2007,28(5): 754-759
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- [7] Benoit,D.,L. Dusseau,M. Glaser,et al.,Performance studies of an optical fiber OSL/RL dosimetry system in pulsed high-intensity radiation beams,Radiation Measurements,2010. 45(3-6): 688-690[J].journ
- [8] Benoit,D.,P. Garcia,S.M. Vaille,et al.,Real-Time Fibered Optically Stimulated Luminescence Dosimeter Based on SrS: Ce,Sm Phosphor,Ieee Transactions on Nuclear Science,2008. 55(4): 2154-2160[J].journ
- [9] Nanto,H.,Y. Hirai,M. Ikeda,et al.,A novel image storage sensor using photostimulated luminescence in SrS: Eu,Sm phosphor for electromagnetic waves such as X-rays,UV-rays and visible light,Sensors a
- [10] Sun,Y.R.,Z.Y. Chen,Y.W. Fan,et al.,A CaS: Ce,Sm-based dosimeter for online dosimetry measurement,Nuclear Science and Techniques,2011. 22(2): 84-88[J]...():-endPag
- [11] Yoo,S.H., C.K. Kim,Nanocomposite Encapsulation of CuS: Eu Light-Emitting Diode Phosphors for the Enhancement of the Stability Against Moisture,Journal of the Electrochemical Society,2009. 156(7): J
- [12] Avci,N.,J. Musschoot,P.F. Smet,et al.,Microencapsulation of Moisture-Sensitive CaS: Eu<sup>2+</sup> Particles with Aluminum Oxide,Journal of the Electrochemical Society,2009. 156(11): J333-J337[J].
- [13] Gang,S.R.,D. Kim,S.M. Kim,et al.,Improvement in the moisture stability of CaS: Eu phosphor applied in light-emitting diodes by titania surface coating,Microelectronics Reliability,2012. 52(9-10):
- [14] Kim,C.K., S.H. Yoo,Changes in the Moisture Stability of CaS: Eu<sup>2+</sup> Phosphors with Surface Coating Methods,Macromolecular Research,2009. 17(11): 907-911[J]...():-en
- [15] Guo,C.F.,B.L. Chu,M.M. Wu,et al.,Oxide coating for alkaline earth sulfide based phosphor,Journal of Luminescence,2003. 105(2-4): 121-126[J]...():-
- [16] Guo,C.,B. Chu,Q. Su,Improving the stability of alkaline earth sulfide-based phosphors,Applied Surface