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Simulation of atomic force microscopy operation via 3D finite element modelling

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In this study, numerical modelling of a micro scale friction measurement method by atomic force microscopy (AFM) is presented.

Numerical modelling of AFM experiment is presented with the aim of exploring friction mechanisms at the micro scale. Asa starting point for this work, comparisons between FE (finite element) models and previously reported mathematical models for stiffness calibration of cantilevers (beam and V-shaped) are presented and discrepancies highlighted. A colloid probe model[1] was developed and its normal and shear interaction were investigated exploring the response of the probe accounting for inevitable imperfections in its manufacture. The material properties of the cantilever had significant impact on both normal and lateral response, even local yielding was found in some areas. The sensitivity of the response in both directions was explored and found that it was higher in normal than in lateral. In lateral measurement, generic response stages were identified, comprising a first stage of twisting, followed by lateral bending, and then slipping. This was present in the two cantilever types explored (beam and V-shaped).Additionally, an emulation model was designed to explore dynamic sensitivity by comparing the simulation of a hysteresis loop with previously reported experiment and the results show good agreement in response pattern. The ability to simulate the scan over an inclined surface representing the flank of an asperity was also demonstrated.

Experimental works have been attempted for exploring issues of importance in friction measurement including establishing dynamic sensitivity.

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[1] A colloid probe comprises a plain cantilever on which a particle is adhered.

Keywords: AFM, FEM, cantilever stiffness calibration, colloid probe, dynamic sensitivity

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고색재현성 $(La,Y)(V,P)O_4:Eu^3$ 적색형광체

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LCD(Liquid Crystal Display)는 CRT(Cathode Ray Tube), PDP(Plasma Display Panel), FED(Field Emission Display) 등과는 달리 자체적으로 발광을 할 수 없기 때문에 화면 전체를 균일하게 밝혀주는 별도의 광원이 필요하다. 현재, 그러한 광원으로 냉음극형광램프(Cold Cathode Fluorescent Lamp)가 저비용, 고효율, 긴 수명 등의 장점을 가지고 있어 백라이트(Backlight)에 사용되고 있다. CCFL에 사용되는 형광체는 254 nm의자외선 파장을 흡수하여 가시광선을 방출하는 물질로, Y_2O_3:Eu, $LaPO_4$:Ce, Tb, $BaMgAl_{10}O_{17}$:Eu이 각각 적색, 녹색, 청색 형광체로 주로 사용되고 있으나 색재현 범위가 낮다는 단점을 가지고 있다. 이에 따라 고색재현성을 나타내는 새로운 형광체들이필요하다.

본 연구에서는 (La, Y)(V, P)O_4:Eu_3 의 형광체를 합성하여 254nm의 자외선 여기 조건하에서 발광특성을 조사하였다. La과 Y의 비율을 변화시켜 측정한 발광 및 여기 스펙트럼으로부터 $(La_{0.05}Y_{0.85})(V_{0.80}P_{0.20})O_4$:0.10Eu에서 발광휘도가 적색 상용형광체(Y_2O_3:Eu) 대비 110%의 최대 발광휘도를 나타내었으며 CIE 색좌표가 (0.668, 0.331)로 상용형광체(0.647, 0.343)보다 우수하였다. 측정 온도를 상온에서 200℃까지 변화시키면서 온도가 형광체 발광휘도에 미치는 영향을 조사하였다. 한편, (La, Y)(V, P)O_4:Eu_3 의 형광체는 진공자외선에 대한 우수한 흡수특성을 나타내므로 PDP용 적색형광체로의 발광특성을 측정하였다.

Keywords: 색재현성, 적색형광체, CCFL