CHARACTERIZATION OF LITHIUM-MAGNESIUM-TELLURITE DOPED WITH ERBIUM AND NEODYMIUM GLASS

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This thesis is specially dedicated to:

To my beloved daddy (Roslan Bin Paiman)
My mother (Jamiah Binti Supar),
my siblings,
and all my friends.

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ABSTRACT

Tellurite glass based on (78-x)TeO_2-10Li_2O-10MgO-2Nd_2O_3-xEr_2O_3, (where x = 0.4 to 2.0 mol %) has successfully been prepared by melt-quenching technique. The colour of glass is found to vary from light violet to dark violet as the Er_2O_3 content is increased. No definite peaks are found from the X-ray diffraction pattern, which shows that the glass is amorphous in nature. It also found that the densities and the molar volume of the glass increase as the Er_2O_3 content is increased. The glass transition temperature (T_g), crystallization temperature (T_c), melting temperature (T_m) and the temperature difference (T_c-T_g) are determined by means of Differential Thermal Analysis (DTA). It is found that the T_c, T_g and T_m are in the range of (419-430) ^oC, (300-345) ^oC and (885-890) ^oC respectively. Meanwhile, the vibrational study is conducted using the Infrared spectroscopy in the range of (4000-400) cm^{-1}. Two major absorption peaks are observed around (1600-3600) cm^{-1}, and (900-1200) cm^{-1} which are due to the stretching mode vibration of OH peak and Te-OH peak respectively. The optical absorption edge is studied using UV-Vis spectroscopy. The result shows that the optical band gap (E_{opt}) and Urbach Energy (ΔE) are in the range of (3.038-3.130) eV and (0.334-0.321) eV respectively, depending on the Er_2O_3 concentration. The refractive index is evaluated using the Sellmeier's equation and it is found that the value in the visible region is in the range of 1.724-1.781 depending on the Er_2O_3 content. The emission spectrum is recorded using the photoluminescence spectrometer excited at 582 nm at room temperature. The result shows that the emission spectrum of Er^{3+} and Nd^{3+} consist of five emission bands at ~457 nm, ~495 nm, ~556 nm, ~611 nm, and ~ 665 nm which can be assigned as a transition of $^4F_{7/2} \rightarrow {}^4F_{15/2,}$ $^4S_{3/2} \rightarrow {}^4F_{15/2}$, $^4G_{11/2} \rightarrow {}^4I_{9/2}$, $^4G_{11/2} \rightarrow {}^4I_{15/2}$ and $^4G_{7/2} \rightarrow {}^4I_{13/2}$ respectively.

ABSTRAK

Kaca Tellurit berasaskan (78-x)TeO_2-10Li_2O-10MgO-2Nd_2O_3-xEr_2O_3, (dengan $0.4 \leq x \leq 2.0$ mol %) telah berjaya disediakan menggunakan teknik pelindapan leburan. Warna kaca didapati berubah dari ungu terang kepada ungu gelap apabila kandungan Er_2O_3 bertambah. Corak pembelauan sinar-X tidak menunjukkan puncak yang pasti dan ini mengesahkan bahawa kaca tersebut adalah amorfus. Didapati juga bahawa ketumpatan dan isipadu molar kaca bertambah apabila kandungan Er_2O_3 bertambah. Suhu peralihan kaca (T_g), suhu penghabluran (T_c), suhu leburan (T_m) dan perbezaan suhu (T_c-T_g) telah ditentukan menggunakan Penganalisis Pembezaan Terma. Didapati bahawa T_c, T_g dan T_m masing-masing berada dalam julat (419-430) ^oC, (300-345) ^oC and (885-890) ^oC. Sementara itu, kajian terhadap getaran telah dilakukan menggunakan spektroskopi inframerah dalam julat (4000-400) cm^{-1}. Dua puncak utama diperolehi disekitar (1600-3600) cm^{-1}, dan (900-1200) cm^{-1} yang masing-masing merujuk kepada puncak mod getaran regangan OH dan Te-OH . Pinggir serapan optik dikaji menggunakan spektroskopi ultraviolet cahaya nampak. Didapati bahawa jurang tenaga, E_g dan tenaga Urbach, ΔE masing-masing adalah di sekitar (3.038-3.130) eV dan (0.334-0.321) eV, bergantung kepada kandungan Er_2O_3. Indek biasan telah ditentukan menggunakan persamaan Sellmeier dan didapati bahawa nilainya dalam julat cahaya nampak adalah 1.724-1.781, bergantung kepada kandungan Er_2O_3. Spektrum pancaran telah direkod menggunakan spektrometer fotoluminesen yang diujakan pada 582 nm pada suhu bilik. Keputusan menunjukkan bahawa spektrum pancaran Er^{3+} dan Nd^{3+} terdiri daripada empat jalur pada ~457 nm, ~495 nm, ~556 nm, ~611 nm, dan ~665 nm dengan masing-masing mewakili transisi dari $^4F_{7/2} \rightarrow {}^4F_{15/2,}$ $^4S_{3/2} \rightarrow {}^4F_{15/2}$, $^4G_{11/2} \rightarrow {}^4I_{9/2}$, $^4G_{11/2} \rightarrow {}^4I_{15/2}$ and $^4G_{7/2} \rightarrow {}^4I_{13/2}$.