

## C1

# CHARACTERISTICS OF TITANIUM DIOXIDE NANOTUBES ANNEALED UNDER VARIOUS CONDITIONS AND QUENCHED USING LIQUID NITROGEN

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**ABSTRACT-** This paper presents the effects of the different annealing treatments and quenching conditions on the characteristics of titanium dioxide nanotubes (TNTs), which were synthesised successfully via two-step anodization. The X-ray diffraction (XRD) showed that TNTs annealed and quenched using liquid nitrogen (N<sub>2</sub>) exhibited significant dissimilarities in the phase transition and plane dominance, as compared to that of air quenched. It also revealed that the liquid N<sub>2</sub> quenching was capable of suppressing the phase transition of anatase into rutile. Apart from that, the elemental analysis showed that liquid N<sub>2</sub> quenching led to Leidenfrost effect, which had affected the Ti:O ratio of the TNTs significantly. Morphologically, the use of controllable water vapour/N<sub>2</sub> was found to be able to preserve the nanotubular structures, even at the high annealing temperature of 850 °C. From the optical aspect, the bandgap energy of all samples were found to decrease when the annealing temperatures increased, regardless of the annealing and quenching conditions. Particularly, the crystal structure of TNTs was found to exert greater effect on their bandgap energy, as compared to that of crystallite size when the annealing temperatures were varied between 650 °C and 850 °C.

**Keywords:** Titanium dioxide nanotubes, Liquid nitrogen, Phase transition, Water vapour, Bandgap energy.