Source details

Journal of Solid State Chemistry

Scopus coverage years: from 1969 to Present

Publisher: Elsevier

ISSN: 0022-4596 E-ISSN: 1095-726X

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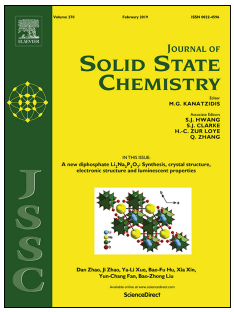


Evidence of oxygen and Ti vacancy induced ferromagnetism in post-annealed undoped anatase TiO_2 nanocrystals: A spectroscopic analysis

Shyamsundar Ghosh, P.M.G. Nambissan

PII: S0022-4596(19)30180-X

DOI: https://doi.org/10.1016/j.jssc.2019.04.010

Reference: YJSSC 20711

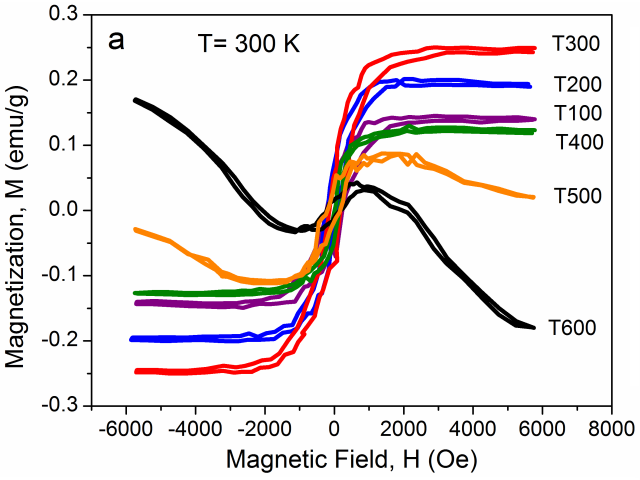
To appear in: *Journal of Solid State Chemistry*

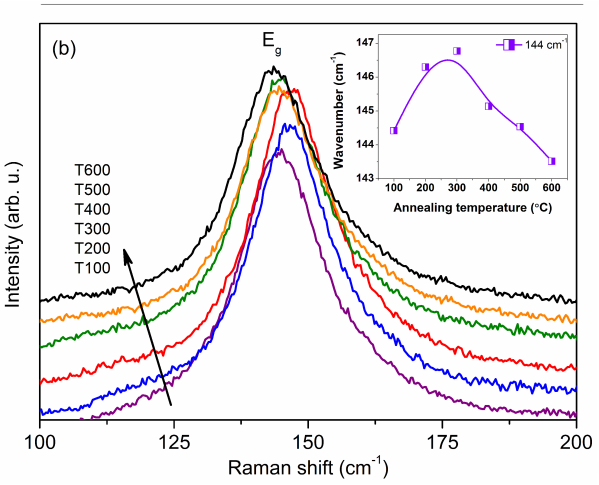
Received Date: 3 March 2018

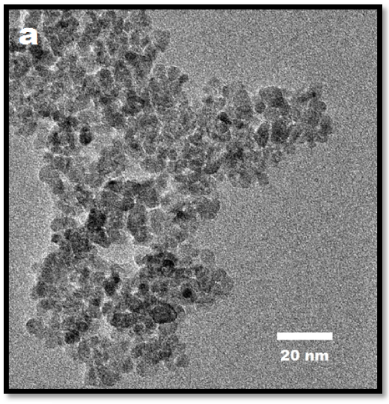
Revised Date: 14 March 2019

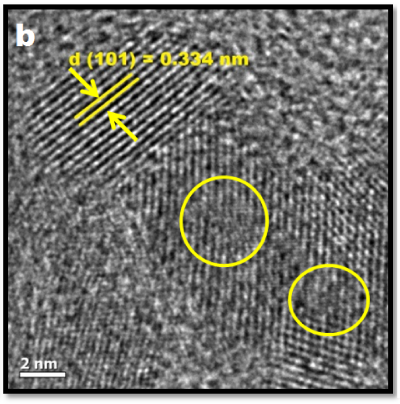
Accepted Date: 9 April 2019

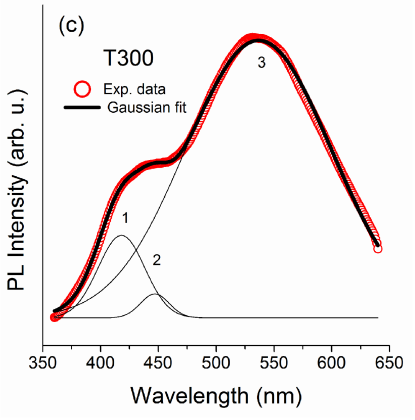
Please cite this article as: S. Ghosh, P.M.G. Nambissan, Evidence of oxygen and Ti vacancy induced ferromagnetism in post-annealed undoped anatase TiO_2 nanocrystals: A spectroscopic analysis, *Journal of Solid State Chemistry* (2019), doi: https://doi.org/10.1016/j.jssc.2019.04.010.


a
T= 300 K
T300
T200
T100
T400
T500
T600
Magnetization, M (emu/g)
Magnetic Field, H (Oe)


(b)
E_g
T600
T500
T400
T300
T200
T100
Intensity (arb. u.)
Raman shift (cm^-1)
144 cm^-1
Wavenumber (cm^-1)
Annealing temperature (°C)


a
20 nm


b
d (101) = 0.334 nm
2 nm


(c)
T300
Exp. data
Gaussian fit
1
2
3
PL Intensity (arb. u.)
Wavelength (nm)

Evidence of oxygen and Ti vacancy induced ferromagnetism in post-annealed undoped anatase TiO_2 nanocrystals: A spectroscopic analysis

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ABSTRACT

The evidence of oxygen and titanium (Ti) vacancy induced room-temperature ferromagnetism (RTFM) is observed in anatase TiO_2 nanocrystals investigated by spectroscopic techniques. RTFM significantly depends on the annealing temperature due to modification of intrinsic defects. Magnetic moment (M_S) and Curie temperature (T_C) are found to increase initially with increase of annealing temperature and then decreases on further annealing. The samples annealed at lower temperature, is found to possess significant amount of singly ionized oxygen vacancy (V_O^+) defects. In addition, coincident doppler broadening and positron annihilation spectroscopic analysis provides an indication that such oxygen vacancy may merge with one or two Ti vacancy (V_{Ti}) and thereby forming larger-sized defect-combinations like divacancy V_{Ti+O} and trivacancy $V_{Ti+O+Ti}$ which act as dominant positron trapping centre within the nanocrystalline TiO_2. Hence, the combination of V_O and V_{Ti} defects play the critical role in inducing RTFM in TiO_2 nanocrystals which can yield promising spintronic applications.

Keywords: TiO_2 Nanocrystals; Oxygen and Ti vacancy defects; Ferromagnetism; Photoluminescence.

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