

# Metal Oxide Nanostructures & Composites for Ionizing Radiation Detection and Measurement

A Thesis submitted by  
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*in partial fulfilment of the requirements for the award of the degree of*  
**Doctor of Philosophy**



॥ त्वं ज्ञानमयो विज्ञानमयोऽसि ॥

**Indian Institute of Technology Jodhpur**  
**Department of Physics**

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## Declaration

I hereby declare that the work presented in this Thesis titled "*Metal Oxide Nanostructures & Composites for Ionizing Radiation Detection and Measurement*" submitted to the Indian Institute of Technology Jodhpur in partial fulfilment of the requirements for the award of the degree of Doctor of Philosophy, is a bonafide record of the research work carried out under the supervision of Dr. Ambesh Dixit. The contents of this thesis in full or in parts, have not been submitted to, and will not be submitted by me to, any other Institute or University in India or abroad for the award of any degree or diploma.

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## Certificate

This is to certify that the thesis titled "*Metal Oxide Nanostructures & Composites for Ionizing Radiation Detection and Measurement*", submitted by *Ram Milan Sahani (P16PH002)* to the Indian Institute of Technology Jodhpur for the award of the degree of *Doctor of Philosophy*, is a bonafide record of the research work done by him under our supervision. To the best of our knowledge, the contents of this report, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

*Dr. Ambesh Dixit*  
Ph.D. Thesis Supervisor



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## List of Symbols

<i>Symbol</i>	<i>Description</i>
a.m.u.	Atomic Mass Unit
<sup>241</sup> Am	Americium-241
Bq	Becquerel
<sup>252</sup> Cf	Californium-252
Ci	Curie
Co	Cobalt-60
<sup>137</sup> Cs	Caesium-137
e <sup>-</sup> , e <sup>+</sup>	Electron, Positron
Gy	Gray
K-40	Potassium-40
n	Neutron
p	Proton
<sup>238</sup> Pu, <sup>239</sup> Pu	Plutonium-238, 239
<sup>226</sup> Ra	Radium-226
<sup>222</sup> Rn	Radon-222
<sup>90</sup> Sr- <sup>90</sup> Y	Strontium-Yttrium-90
Sv	Sievert
t	Counting time
<sup>232</sup> Th	Thorium-232
<sup>238</sup> U	Uranium-238
Z	Atomic Mass
α	Alpha
β	Beta
γ	Gamma
ε	Detection efficiency
ν, $\bar{\nu}$	Neutrino, Antineutrino
σ	Standard Deviation

## List of Abbreviations

*Abbreviation Full form*

ADC	Analog to Digital Converter
CW-OSL	Continuous Wave Optically Stimulated Luminescence Dosimeter
CZT	Cadmium Zinc Telluride
DBE	Defect Band Emission
D-D	Deuteron -Deuteron
D-T	Deuteron-Triton
EBRT	External Beam Radiotherapy
FAST	Field Assisted Sintering
FNM	Fast Neutron Monitoring
GI	Gastro Intestinal
GZO	Gallium Doped Zinc Oxide
HPLT	High Pressure Low Temperature
HT	High Temperature
KERMA	Kinetic Energy Released Per Unit Mass
LM-OSL	Linearly Modulated Optically Stimulated Luminescence Dosimeter
LPE	Liquid Phase Epitaxy
MCA	Multi Channel Analyzer
MDA	Minimum Detectable Activity
MDD	Minimum Detectable Dose
NBE	Near Band Edge
NORM	Naturally Occurring Radioactive Materials
NVD	Nausea, Vomiting and Diarrhea
OSL	Optically Stimulated Luminescence Dosimeter
PMMA	Polyethylene Methyl Methacrylate
PMT	Photo Multiplier Tube
PSPMT	Position Sensitive Photo Multiplier Tube
SEM	Scanning Electron Microscopy
SPS	Spark Plasma Sintering
SDD	Source To Detector Distance
TLD	Thermo-luminescent Dosimeter
TTIP	Titanium Tetraisopropoxide
UHP	Uniaxial Hot Press
XRD	X ray Diffraction
ZnO	Zinc Oxide

