Optoelectronics and Semiconductor Group
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Field of study: Nanotechnology, Semiconductor Characterization, Crystal Growth
Key words: Nanostructure, Modulation Spectroscopy, Surface Photovoltage Spectroscopy, RF Sputtering, MOCVD, Raman Scattering
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1. Subjects of Research

(1) Growth and characterization of well-aligned 1-D RuO_2 and IrO_2 Nanocrystals. Study the possible applications of these nanostructured oxides.
(2) Develop contactless nondestructive optical characterization techniques; (i) modulation spectroscopy, (ii) surface photovoltage spectroscopy and (iii) Raman scattering, for semiconductor characterization.
(3) Growth and characterization of single crystals of transition metal dichalcogenides and dioxides with pyrite, layered or rutile structures by using flux, chemical vapor transport or physical vapor transport methods.

2. Recent Research Topics

(1) Growth and characterization of well-aligned one-dimensional RuO_2 and IrO_2 nanocrystals via RF sputtering and MOCVD methods. A detailed characterization program including XRD, EDX, FESEM, TEM, XPS and Raman scattering are used for these 1D materials study. The study of field emission properties of the vertically-aligned oxide-nanotips and demonstrated as the high performance and robust field emitter materials owing to their low work function, low resistivity and excellent stability against oxygen.

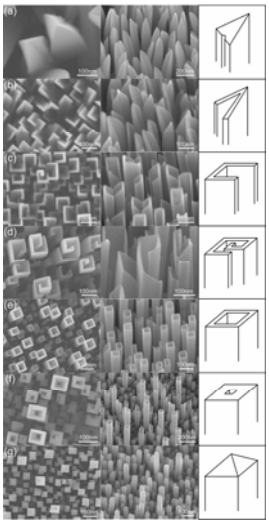

Fig.1 Images of various vertically aligned IrO_2 1D nanocrystals

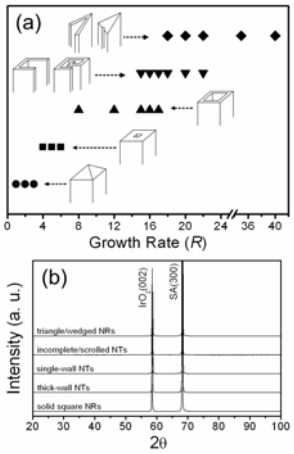

Fig.2 The morphology distribution as a relationship with growth rate for all the IrO_2 1D naoocrystals.

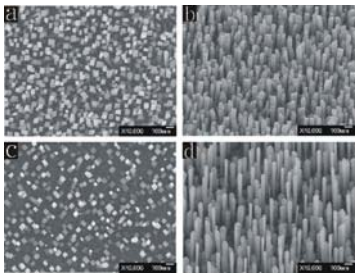

Fig. 3 FESEM images of the RuO_2 nanorods grown on $LiNbO_3$(LNO)(100) and sapphire(SA)(100) substrates.

(2) Using modulation spectroscopy, surface photovoltage spectroscopy and Raman scattering for semiconductor characterization including bulk/thin films,

surfaces/interfaces, micro- and nano-structures, and the actual device structures.

(3) Growth and characterization of single crystals and nanocrystals of transition metal dichalcogenides and dioxides with pyrite, layered or rutile structures by using flux, chemical vapor transport or physical vapor transport methods

3. Selected Publications and Projects

(1) Publications

(i) Chen, R. S., A. Korotcov, **Y. S. Huang**, D. S. Tsai, "One dimensional conductive IrO_2 nanocrystals," Nanotechnology, Vol.17, pp.R67~R87 (2006).

(ii) Chan, C. H., H. S. Chen, C. W. Kao, H. P. Hsu, **Y. S. Huang**, and J. S. Wang, "Investigation of multilayer electronic vertically coupled InAs/GaAs quantum dot structure using surface photovoltage spectroscopy," Appl. Phys. Lett., Vol.89, pp.022114-1~022114-3 (2006).

(iii) Korotcov, A., **Y. S. Huang**, T. Y. Tsai, D. S. Tsai, and K. K. Tiong, "Effect of length, spacing and morphology of vertically aligned RuO_2 nanostructures on field emission properties," Nanotechnology, Vol.17, pp.3149-3153 (2006).

(iv) Korotcov, A. V., **Y. S. Huang**, D. S. Tsai, and K. K. Tiong " Raman scattering characterization of vertical aligned 1D IrO_2 nanocrystals grown on single crystal oxide substrates," Solid State Communications, Vol.137, pp.310~314 (2006).

(v) Chen, R. S., H. M. Chang, **Y. S. Huang**, D. S. Tsai, and K. C. Chiu, "Morphological evolution of the self-assembled IrO_2 one-dimensional nanocrystals," Nanotechnology, Vol. 16, pp. 93-97 (2005)

(vi) **Huang, Y. S.** and F. H. Pollak, "Non-destructive, room temperature, characterization of wafer-sized III-V semiconductor device structures using contactless electromodulation and wavelength-modulated surface photovoltage spectroscopy," phys. stat. sol. (a), Vol.202, pp.1193-1207 (2005).

(vii) Liu, Y. T., P. Sitarek, **Y. S. Huang**, F. Firszt, S. Łęgowski, H. Męczyńska, A. Marasek, W. Paszkowicz, and K. K. Tiong, "Temperature dependence of the edge excitonic transitions of the wurtzite $Cd_{1-x-y}Be_xZn_ySe$ crystals," J. Appl. Phys., Vol.98, pp.083519-1~083519-7 (2005).

(viii) Chen, R. S., **Y. S. Huang**, Y. M. Liang, C. S. Hsieh, D. S. Tsai and K. K. Tiong, "Field emission from conductive vertically aligned IrO_2 nanorods," Appl. Phys. Lett., Vol. 84, pp. 1552-1554 (2004).

(2) Projects

(i) Nanostructured conductive oxides: RuO_2 and IrO_2 (National Science and Technology Program for Nanoscience and Nanotechnology, 2004-2007)

(ii) Optical properties study of novel optoelectronic semiconductor materials, low dimensional nanostructures and device structures (NSC: 2005-2008)

(iii) Growth, characterization and possible applications study of transition metal dioxide and dichalcogenide compounds: single crystals, films and their nanosized structures (NSC: 2005-2008)