CURRICULUM VITAE

Sofi Suhail Majid

Date of Birth: - January 01, 1990

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Ph.D. in Physics (2014-2019):

Title: "Study of insulator to metal transition in doped and undoped Vanadium oxide thin films"

Supervisors: Dr. Faiyazur Rahman department of Physic, AMU, Aligarh & Dr. Dinesh Kumar Shukla, UGC-DAE, Consortium for Scientific Research, Indore, India

Institutes: Department of physics, AMU, Aligarh, India & UGC-DAE, Consortium for Scientific Research, Indore, M.P, India.

Year of award: September, 2019.

Postdoc in Optical Physics (2019-2020): **"**THz field to induce transient phonon and electronic dynamics in Lead Halide Perovskite Materials"

Supervisor: Dr. Yu-Chieh Wen

Institute: Academia Sinica, No.128, Sec. 2, Academia Rd.Nangang Dist., Taipei City, Taiwan.

Area of Specialization: Experimental Condensed Matter Physics and Ultrafast Laser Optics

Description of previous work and technical skills:

Keywords: *Strongly correlated materials, Perovskite Halides, Insulator to metal transition, electron-electron correlations, electron-lattice interactions, Ultrafast pump probe and time domain THz spectroscopy, Raman spectroscopy, X-ray absorption spectroscopy, Photoemission spectroscopy, Pulsed laser deposition.*

My Postdoc research work involves understanding of the phonon induced bandgap modulation and the control of giant Rashba effect in organic-inorganic hybridized lead halide perovskites, which can be made possible by the state of art of ultrafast THz technology. Lead halide perovskites have been subject of an enormous potential in optoelectronic and thin film solar cells due to high photovoltaic performance resulting from the long carrier diffusion lengths, long carrier lifetimes, which can be explained in terms of the polaronic effect and the indirect band gap caused by spin polarized band structure due to Rashba effect. I use time domain THz spectroscopy to unveil the changes in bandgap of the perovskite halide thin films induced by the THz excitation of coherent phonon modes. In this way one can deduce the polaronic effect, which has been found key to explain the high photovoltaic performance in perovskite halide materials.

In my Ph.D. work, I tried to understand the nature of the insulator to metal transition (IMT) in the electron correlated systems like VO_2 and V_2O_3 thin films. Nature of the IMT in these compounds has remained elusive, whether Peierls assisted (involving electron-lattice interactions) or Mott-Hubbard type (involving electron-electron correlations). My research required study of their electrical, structural, optical and electronic properties.

I have used pulsed laser deposition system to synthesize high quality Vanadium oxide thin films and performed X-ray diffraction and resistivity measurements to study the crystalline structure and IMT in thin films. I have also used ultrafast transient pump-probe reflectivity set up to study the photoinduced IMT in different insulating phases of the VO_2 and explored the role of their different structural arrangements in the decay dynamics of photoinduced charge carriers. I have carried out both the fluence and the temperature dependent ultrafast reflectivity measurements on VO_2 thin films. I have employed temperature dependent Raman spectroscopy to identify different insulating phases of the VO_2 and study the electron lattice interaction accompanying the structural transition in both, the VO_2 and the V_2O_3 thin films. For complete electronic structure studies, I have used temperature dependent soft X-ray absorption spectroscopy (SXAS) and resonant photoemission spectroscopy (PES) measurements performed at BL-01, Indus 2 and BL-02, Indus 1, Indian synchrotron source, RRCAT, Indore. I have also performed temperature dependent hard X-ray near edge absorption spectroscopy measurements at P09, PETRA III, DESY, Hamburg, Germany. For practical applications, VO_2 based smart thermochromic windows utilize regulation of the infrared transmittance accompanied with the IMT. In this direction I have performed temperature dependent UV-VIS spectroscopy measurements and made an attempt to study W and Tb doped VO_2 thin films and explore the trades-offs between their optical and IMT properties.

Mathematical/graphical Tools and software

- Data Simulation and plotting: CTM-XAS, Origin 8.5 pro
- Documentation: Latex
- Programming Skill: MATLAB, Fortran
- Instrument Interface Language: LabVIEW
- Spectroscopic analysis: Athena, XPSPEAK 4.

Experimental hands on experience:

- Complete construction and operation of time domain THz (generated by Air plasma) setup and its utilization to study Perovskite Halide samples and other similar systems.
- Operation of ultra-fast pump probe reflectivity setup to study the decay dynamics of charge carriers in oxide thin films.
- Full operation of Pulsed Laser Deposition system for synthesis of Oxide thin films.
- Developed temperature dependent resistivity setup (450 K to 4 K) with provision to apply electric fields option.
- Operation of temperature dependent dielectric setup (550 K to 4 K).
- X-ray absorption and Angle Integrated Photoemission Spectroscopy (AIPES) measurements performed at BL-01, Indus 2 and BL-02, Indus 1, Indian national synchrotron source, Raja Ramanna Center for Advanced Technologies, Indore.
- Hard X-ray absorption spectroscopy (V K edge XANES) measurements performed at beamline P09, PETRA III, DESY, Hamburg, Germany.

Instrumentation experience at my own laboratory

- Ultrafast THz pump and Mid IR or optical probe spectroscopy.
- Temperature dependent resistance measurement set up with provision to applied electric field (300 K to 4 K).
- Temperature dependent photoconductivity and Infrared transmittance measurement set up (300 K to 450 K).
- Temperature dependent dielectric measurement set up (300 K to 4 K).

Awards & Honors

- Best poster award for poster presentation of paper entitled "Electronic structure studies of hydrothermally synthesized W doped Vanadium dioxide" presented in International Conference on Nanotechnology for Better Living, 25-29 May (2016) jointly organized by NIT Srinagar and IIT Kanpur at NIT Srinagar-Kashmir.
- Best oral presentation of paper entitled "Structural, electrical and electronic studies of Vanadium oxide thin films" on National Science Day Celebrations- (2016), Department of Physics, Aligarh Muslim University, Aligarh.
- Best poster (CMM38) award in International Conference on Recent Trends in Physics ICRTP, February 13-14 (2016) organized by School of Physics Devi Ahilya University, Indore.
- Oral presentation award on Annual Science Day celebrations, December 18-19 (2015) at UGC-DAE Consortium for Scientific Research, Indore.

List of Publications (International journals)

1. **S. S. Majid**, S. R. Sahu, A. Ahad, K. Dey, K. Gautam, F. Rahman, P. Behera, U. Deshpande, V. G. Sathe, and D. K. Shukla "Role of V-V dimerization in the insulator-

metal transition and optical transmittance of pure and doped VO_2 thin films", Phys. Rev. B **101**, 014108 (2020).

2. **S. S. Majid**, D. K. Shukla, F. Rahman, S. Khan, K. Gautam, A. Ahad, S. Francoual, R. J. Choudhary, V. G. Sathe, and J. Strempfer, "Insulator-metal transitions in the T phase Cr-doped and M1 phase undoped VO_2 thin films" Phys. Rev. B **98**, 075152 (2018).
3. **S. S. Majid**, D. K. Shukla, F. Rahman, K. Gautam, R. J. Choudhary, V. G. Sathe, and D. M. Phase "Stabilization of metallic phase in V_2O_3 thin film" Appl. Phys. Lett, **110**, 173101 (2017).
4. Abdul Ahad, K. Gautam, K. Dey, **S. S. Majid**, F. Rahman, S. K. Sharma, J. A. H. Coaquira, Ivan da Silva, E. Welter, and D. K. Shukla, "Magnetic correlations in subsystems of the misfit $[Ca_2CoO_3]_{0.62}[CoO_2]$ cobaltate", Phys. Rev. B 102, 094428 (2020).
5. Abdul Ahad, K. Gautam, **S. S. Majid,** S. Francoual, F. Rahman, Frank M. F. De Groot, and D. K. Shukla, "Origin of the high Seebeck coefficient of the misfit $[Ca_2CoO_3]_{0.62}[CoO_2]$ cobaltate from site-specific valency and spin-state determinations", Phys. Rev. B 101, 22020, R (2020).
6. K. Gautam, **S. S. Majid**, S. Francoual, A. Ahad, K. Dey, M. C. Rahn, R. Sankar, F. C. Chou, and D. K. Shukla, "Magnetic and orbital correlations in multiferroic CaMn7O12 probed by x-ray resonant elastic scattering" Phys. Rev. B **101**, 224430 (2020).
7. K. Gautam, A. Ahad, K. Dey**, S. S. Majid**, S. Francoual, V. G. Sathe, Ivan da Silva, and D. K. Shukla, "Symmetry breaking and spin lattice coupling in $NdCrTiO_5$" Phys. Rev. B **100**, 104106 (2019).
8. K. Gautam, Abdul Ahad, **S.S. Majid**, A. Sagdeo, S. Francoual, R. J. Choudhary, D.K. Shukla, "Deciphering the role of Fe+3 substitution in modulating the structural, magnetic and magnetocaloric properties of $NdCrTiO_5$" Journal of magnetism and magnetic materials 478 260-263 (2019).
9. A. K. Vishwakarma, **S. S. Majid**, L. Yadava, "XANES analysis and structural properties of CdS-doped TiO2" Vacuum **165,** 239-245 (2019).
10. Abdul Ahad, D. K. Shukla, F. Rahman, K. Gautam, K. Dey**, S. S. Majid**, S. K. Sharma, and J. A. H. Coaquira,"Griffiths-like phase and charge-spin glass state in La1.5Sr0.5CoO4" Appl. Phys. Lett, **113**,102405 (2018).
11. Abdul Ahad, D.K. Shukla, F. Rahman, **S. S. Majid**, Tarachand, G.S. Okram, A.K. Sinha, D.M. Phase "Colossal thermopower, spin states and delocalization effects in single layered $La_{2-x}Sr_xCoO_4$" Acta Mater., **135**, 233-243 (2017).

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I hereby confirm that all the information given above is true to best of my knowledge.

Dated: 18-11-2020

Place: Taipei, Taiwan **Sofi Suhail Majid**