Innovation and Global Cooperation for Sustainability
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IIT Indore - LU Hannover Partnership

DAAD

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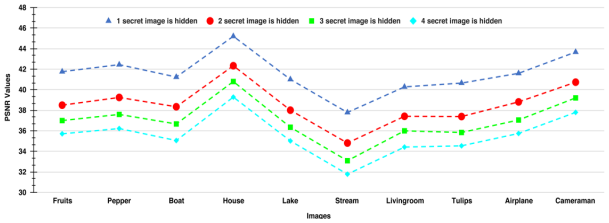
Innovations in Computational Science, Chemistry, Physics and Biosciences

1. Image Analysis

- Developed a new steganography scheme satisfying competing requirements of enhanced embedding capacity, high quality stego-image, and resistance to stego-attacks.
- Highly accurate Thyroid nodule classification using texture exploiting descriptors.



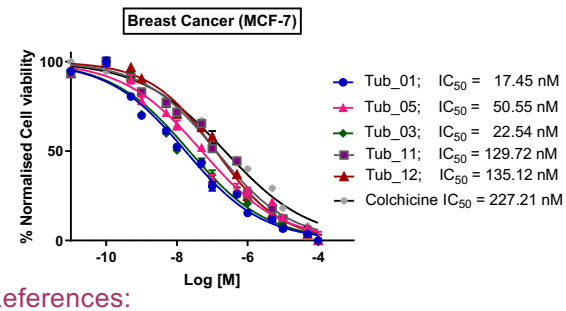
MSSIM index, NCC coefficient, entropy, and NAE of the stego-images when compared with the corresponding cover images.

Cover image	MSSIM	NCC	Entropy		NAE
			Cover image	Stego- image	
Fruits	1	0.9996	7.488	7.496	0.009
Peppers	1	0.9997	7.573	7.603	0.012
Boat	1	0.9998	7.121	7.151	0.012
House	1	0.9998	5.756	6.630	0.007
Lake	1	0.9997	7.471	7.513	0.013
Stream	1	0.9991	7.702	7.719	0.020
Livingroom	1	0.9996	7.431	7.438	0.014
Tulips	1	0.9994	7.713	7.735	0.011
Jetplane	1	0.9998	6.716	6.795	0.008
Cameraman	1	0.9999	7.055	7.133	0.009
Average	**1**	**0.9996**	**7.202**	**7.320**	**0.011**

Stream Cover Image with 4 Mammograms Hidden.

2. Drug Delivery

- New drug-delivery techniques of super magnetic iron nanoparticles and NIR agents for the diagnosis and treatment of cancers such as brain and prostate using protein or receptors overexpression during malignancy.
- Discovery of new cystobactamid antibiotics natural product analogs with enhanced antibacterial activities.
- Small molecule peptides tubulin inhibitors for treatment of cancers.

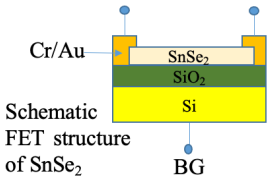


3. Properties of 2D Materials

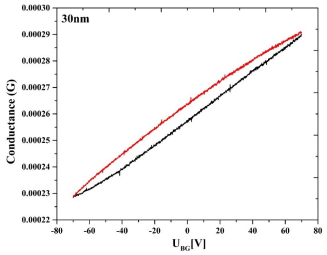
- Study of structural and electronic properties of low-dimensional systems (such as 2D materials) of technological importance.
- Surface modification of 2D layered systems (epitaxial graphene, EG) with a molecular electron acceptor.
- Atomic layer deposition grown low-dimensional system; ultrathin metal-oxide films; structure-property correlations; control in defects & electronic properties; thickness effect.

4. Fabrication from Tin Chalcogenide

- Study of layer–dependent transport properties of 2D SnSe2.
- Thickness-controlled, single crystalline 2D flakes of SnSe2 were synthesized, and an FET was fabricated with various flakes of differing thicknesses.
- We find a semiconductor-to-metal transition from the electrical resistivity versus temperature measurement, that is highly dependent on the layer thickness of the flakes used.

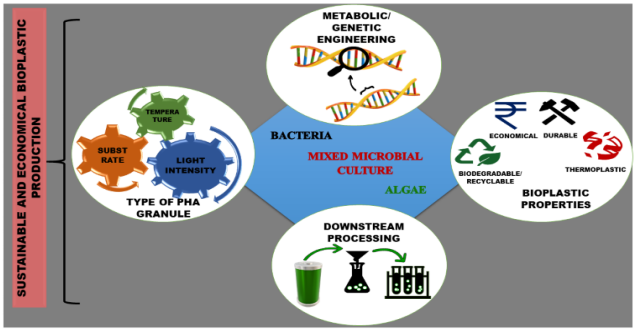


Schematic FET structure of $SnSe_2$



5. Biopolymer Production

- Worked on biopolymer production of algae, bacteria and co-cultures.
- Co-cultivation of algae and bacteria in the same medium gave the possible solution for production of biopolymer (PHA).
- Overall efficiency has found to be increased in the process.



References:

(1) R. Agarwal, K. Ahuja, M. C. Steinbach, and T. Wick, "SABMIS: Sparse Approximation Based Blind Multi-image Steganography Scheme", PeerJ Computer Science, vol. 8, article no. e1080, 2022.

(2) D. P. Benny, V. Munya, A. Ghosh, R. Kumar, D. Pal, H. Pfnür, and S. Chattopadhyay, "Self-Healing of Defect-Mediated Disorder in ZnO Thin Films Grown by Atomic Layer Deposition", Journal of Electronic Materials, vol. 52, pp. 8293–8302, 2023.

(3) V. Chelvam, A. Pandit, C. Sharma, P. Dudhe, A. Kirschning, and G. Draeger, "Ligand Targeted Bio-conjugates with Nanoparticles for Diagnosis and Treatment of Cancers Over-expressing CA IX and PSMA", Indian Patent, 2024.

(4) D. Parida, K. Katare, A. Ganguly, D. Chakraborty, O. Konar, R. Nogueira and K. Bala, "Unravelling the Microbial allies: Metagenomics & Molecular docking Assisted Mitigation of Microplastics Pollution", Chemosphere, vol. 351, article no. 141271, 2024.