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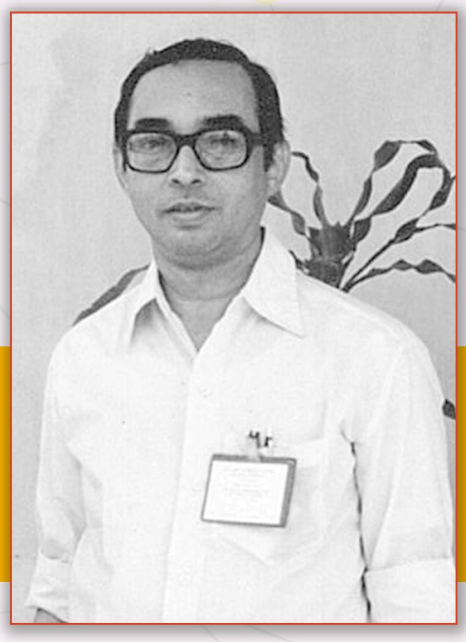
Azadi Ka Amrit Mahotsav



16th C K Majumdar MEMORIAL LECTURE

Date: 8th December 2022
Time: 4:00 PM
Venue: Silver Jubilee Hall

https://meet.google.com/ttk-ynox-crd

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TITLE

Recent Developments in Hybrid Perovskites and Related Materials

ABSTRACT

Hybrid organic-inorganic perovskites comprise a number of important families, including the lead-based halides (e.g. $CH_3NH_3PbI_3$) and the formates (e.g. $[(CH_3)2NH_2]Zn(HCOO)_3$) [1], as well as analogous systems with the perovskite-related ReO3 structure [2]. The lead halide perovskites have attracted a great deal of attention in the last 13 years on account of their excellent performance as active layers in solar cells and other optoelectronic devices. Some of our recent work has focused on the search for lead-free hybrid double perovskites, such as $(CH_3NH_3)2AgBiBr_6$. We shall discuss why it has been difficult to synthesis these double perovskites as iodides [3]. We shall also describe some B-site vacant perovskites based on ruthenium [4], as well as recent developments in the area of hybrid layered double perovskite halides [5]. The perovskite formates are notable for their exciting ferroelectric and multiferroic behaviour, which we discovered in 2008/9. In our most recent work in this area, we have studied the mechanism of the ferroelectric phase transition in $[(CH_3)2NH_2]Mn(HCOO)_3$ using a combination of X-ray crystallography, solid state 2H NMR, and computer simulations [6], and compared its behaviour to that of the analogous azide compound $[(CH_3)2NH_2]Mn(N_3)_3$ [7]. The MIII(HCOO)3 formates (M = Al, Mn, Fe, etc), by contrast, are an emerging class of materials that show exciting potential for CO_2 capture and O_2/N_2 air separation [8].

[1] *Li, Wang, Deschler, Gao, Friend & Cheetham, Nature Rev. Mater. 2, 16099 (2017)* **[2]** *Evans, Wu, Seshadri & Cheetham, Nature Rev. Mater. 5, 196 (2020)* **[3]** *Vishnoi, Seshadri & Cheetham, J. Phys. Chem. C, 125 11756 (2021)* **[4]** *P. Vishnoi et al., Angew. Chemie Intl. Ed. Eng. 59, 8974 (2020); P. Vishnoi et al., Angew. Chemie Intl. Ed. Eng. 60, 5184 (2021)* **[5]** *L. L. Mao et al., J. Amer. Chem. Soc. 141, 19099 (2019); H. A. Evans et al., Ann. Rev. Mater. Sc. 51, 351 (2021); P. Vishnoi et al., J. Amer. Chem. Soc. 144, 6661 (2022)* **[6]** *Li, Li, Xu, Qin, Stroppa, Butler, Howard, Dove, Cheetham, Li, & Bu, J. Amer. Chem. Soc. 144, 816 (2022)* **[7]** *Wei, Li, Butler, Feng, Howard, Gao, Carpenter, Lu, Walsh & Cheetham, Angew. Chemie 57, 8932 (2018)* **[8]** *Evans, Mullangi, Deng, Wang, Peh, Wei, Wang, Brown, Zhao, Canepa & Cheetham, Science Adv. 8, eade1473 (2022)*

SPEAKER

Professor Sir Anthony K. Cheetham, FRS
Materials Research Laboratory, University of California;
Department of Materials Science and Engineering, National University of Singapore

Tony Cheetham is a Research Professor at the University of California, Santa Barbara, and a Distinguished Visiting Professor at the National University of Singapore. He was formerly the Goldsmiths' Professor of Materials Science at the University of Cambridge (2007-2017) and the Treasurer and Vice-President of the Royal Society (2012-2017). Cheetham obtained his D.Phil. at Oxford in 1972 and did post-doctoral work in the Materials Physics Division at Harwell. He joined the Chemistry faculty at Oxford in 1974, and then moved to UC Santa Barbara in 1991 to become Professor in the Materials Department. From 1992-2004 he was the Director of UCSB's Materials Research Laboratory. In January 2020 he was knighted by the Queen for "Services to Materials Chemistry, UK Science and Global Outreach". Cheetham's research interests span both inorganic and hybrid (organic-inorganic) materials, and include the synthesis of novel compositions and the study of their structures and properties. He has worked extensively on framework materials such as aluminosilicate zeolites and metal-organic frameworks, where he has explored electronic, optical and magnetic properties, as well as adsorption processes and separations. He is a member of several national academies, including the Royal Society and the three Indian science academies.