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The story of manganese in quantum dots

Quantum dots, wherein size-dependent properties are often observed, are of great scientific interest as they effectively act as a bridge between the bulk properties and the atomic or molecular properties. Doping transition metal ions in quantum dots provide great flexibility in controlling electronic and magnetic interactions via growth-controlled “engineering” of wave functions giving rise to interesting properties, including lasing, giant magneto-optical properties. Manganese is one of the most extensively studied dopants in this category. This interest is primarily piqued by the interesting orange emission arising from the Mn d-d transition. While the practical observation and manifestations of this emission has led to a number of applications like photo-magnetism, the physics of its origin has continued to intrigue a large number of researchers with its spin forbidden nature.

In this talk, I am going to recount the story of Mn doping in quantum dots spanning last three to four decades covering its origin, growth and the understanding along with the current challenges. I discuss basic physics behind this interesting feature and the applications that make Mn doped quantum dots interesting with novel properties leading to higher efficiency of the desired properties. In addition, I will also discuss the introduction of fundamentally new concepts that were not observed in bulk materials.

Ranjani Viswanatha did her Ph. D. at the Indian Institute of Science under the guidance of Prof. D. D. Sarma on the growth in solution and electronic structure of nanocrystals. Subsequent to her Ph.D. work, she has been worked as a postdoctoral fellow at Prof. Xiagong Peng’s laboratory at the University of Arkansas and at the Los Alamos National Lab in Prof. Victor Klimov's group. She has studied some interesting behavior of these dopants in nanocrystals qualitatively different from the bulk. She is currently working as an associate professor at Jawaharlal Nehru Centre for Advanced Scientific Research. She is the recipient of many awards including INSA young scientist award, C. V. Raman award for young scientist, MRSI award, CRSI award. She is also a member of leading academies like the founder member of Indian National Young Association for Science, young associate of Indian Academy of sciences. Her work has been published in leading journals and she is also a reviewer in many of the leading journals.

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work revolves around some interesting behavior of transition metal dopants in nanocrystals qualitatively different from the bulk. Her work has been published in leading journals and she has been awarded several national awards like SERB POWER Fellowship, Karnataka State C V Raman award, MRSI medal, DST Young Nanoscientist award, Sheikh Saqr Fellowship, founding member of Indian National Young Academy of Science, the INSA young scientist medal and chosen as a young associate of Indian Academy of Science, founder member of Indian National Young Academy of Science among many others. She is also a reviewer in many of the leading journals and has given several talks in leading conferences.