D V G L N Rao, J Material Sci Eng 2016, 5:9(Suppl)
http://dx.doi.org/10.4172/2169-0022.C1.051

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Photonic applications with a protein complex

We have been working on basic nonlinear optics of the protein complex Bacteriorhodopsin (bR) thin polymer films with milliwatt cw lasers. The unique feature of this material is its flexibility. Absorption of a visible photon by bR triggers the photo cycle, starting from the initial B state to the relatively long lived M state via short lived intermediate states. It can revert to the initial B state thermally in milliseconds via short lived intermediate states or can go back directly to B state within nanoseconds by shining blue light. Both life times can be altered by orders of magnitude using chemical methods or genetic mutation. The process of switching between B and M states (chemical isomers) can go in both directions depending on wavelength, intensity and polarization of the incident light offering a variety of possibilities for manipulating amplitude, phase and polarization. Over the years we studied the basic nonlinear optics-four wave mixing, phase conjugation, photo induced anisotropy, etc. We successfully exploited the unique properties for many applications like: All optical switching, modulation, computing, information processing, power limiting for laser eye protection, medical image processing, transient Fourier holography, etc. More recently, we are focusing on optical Fourier techniques for early detection of micro calcifications in mammograms for breast cancer diagnostics. We also developed an innovative technique of Fourier phase contrast microscopy and multimodal optical microscopy for live cell imaging of biological samples. I will present some highlights of our work with particular reference to development of inexpensive biomedical devices.

Biography

D V G L N Rao had a brilliant academic record at Andhra University where he got the BSc (Honors), MSc and DSc degrees and also taught for two years. He spent two years each at Duke and Harvard Universities as Post-doctoral Fellow. He has been teaching at the University of Massachusetts, Boston since 1968 where he is currently Distinguished Professor in the Physics Department. He was elected Fellow of the American Physical Society, Division of Laser Science in 2010 in recognition of a long record of significant contributions to the nonlinear optics of organic materials and their applications to optical power limiting, Fourier phase contrast microscopy and medical image processing. He published over 120 papers in peer reviewed prestigious journals like *Physical Review Letters, Applied Physics Letters, Optics Letters*, etc. He is covering research areas like nonlinear optics, magnetic resonance, microwave absorption, optical Fourier techniques for breast cancer diagnostics, phase contrast and multimodal optical microscopy, etc. He holds 10 patents and one of these on Fourier phase contrast microscopy is recently licensed to industry for marketing the technology.

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