



PRESS RELEASE

IIT Mandi researchers propose a technique to enhance the power output of piezoelectric materials

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MANDI, 7th December 2020: Indian Institute of Technology Mandi researchers have proposed a technique to enhance the power output of piezoelectric materials. In this, researchers have numerically studied piezoelectric materials - materials that interconvert mechanical energy and electrical energy - and have proposed a new arrangement to enhance the electrical output of these materials when subjected to stress.

The results of their work have been published in the journal Engineering Reports. The research paper has been co-authored by researcher scholars, Mr. Raj Kiran, Mr. Sourav Sharma, along with Dr. Anuruddh Kumar, IIT Mandi alumnus currently working at Hanyang University, North Korea, under the supervision of Dr. Rajeev Kumar and Dr. Rahul Vaish, Associate Professors, School of Engineering, IIT Mandi.

"Piezoelectric materials can generate electrical energy when a force is applied on them, and are thus extremely useful", explains Dr. Rajeev Kumar. Such materials can, for example, be used in floor tiles to generate electrical energy from human walking, or on roads, where the weight from the vehicles can power road lights and signals. However, currently, the electrical energy produced by these materials is very low, which limits their applications in real life situations.

"We have developed a technique known as "graded poling" to enhance the power output of piezoelectric materials by more than 100 times", says Dr. Rahul Vaish. The researchers have used numerical techniques to utilize multiple mechanical stresses - bending, compressive and tensile stresses at the top and bottom of the piezoelectric cantilever beams and shear stresses in the mid-section - in order to significantly improve the electrical output.

"The experimental implementation of graded poling is challenging at present", says Dr. Rajeev Kumar. However, the results of this study and the enormous improvements possible through the graded poling technique offers incentive for researchers to develop actual piezoelectric designs that implement the graded poling technique so that the applications can be realised. The researchers recommend possible steps to achieve these designs in practice, such as partially connecting the right face of the sample to ground and top faces being applied with an electric potential.



The promise of generation of higher amounts of electrical energy from mechanical movement can potentially enable applications in which smart devices can be powered simply by human motion. Other applications could include generating power from the soles of footwear equipped with these materials.

Piezoelectric materials can do the reverse as well – generate mechanical motion in response to electrical energy. Thus improving the mechanical-electrical energy interconversion efficiency can enable engineering applications such as reduction of vibration and noise and advanced technological applications such as positioning and steering of satellite antennas in space.

The researchers are extending their work further for more accurate prediction of the effects of the proposed poling technique on the mechanical properties of the material, which will offer better insights into harnessing the advantages of this technique in real life applications.

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About IIT Mandi

Since the first batch of 97 students joined in July 2009, IIT Mandi has grown to currently host 125 faculty and 1,655 students who are enrolled in various programmes of studies in undergraduate, postgraduate and research programmes, and 1,141 alumni. IIT Mandi is a fully residential campus with 1.4 lakh sq. m. buildings completed. It has a guest house with 88 rooms, an 750-seater Auditorium, campus school, sports complex and hospital.

IIT Mandi has four Academic Schools and three major Research Centers. The Schools are: School of Computing and Electrical Engineering, School of Basic Sciences, School of Engineering, and School of Humanities and Social Sciences. The Centers are: Advanced Materials Research Centre (AMRC; set up with an investment of Rs. 60 crore), Centre for Design and Fabrication of Electrical Devices (C4DFED; has Rs. 50 crore worth of fabrication tools), and BioX Centre (has acquired research equipment worth Rs. 15 crore). In 2017, the Department of Biotechnology, Government of India, selected IIT Mandi to lead the prestigious Rs. 10 crore FarmerZone® Project.

To cater to the growing and changing needs of Indian industry and the aspirations of students, IIT Mandi has introduced 7 B.Tech., 7 M.Tech., 5 M.Sc., 4 Ph.D., 1 I-Ph.D and 1 M.A programmes in the past 10 years. The unique, project-oriented B.Tech. curriculum is centered around its 4-year long Design and Innovation stream. From August 2019, IIT Mandi started 3 new and unique B. Tech. programmes in Data Science and Engineering, Engineering Physics, and Dual Degree in Bioengineering.

Since the inception of the Institute, IIT Mandi faculty have been involved in over 275 Research and Development (R&D) projects worth more than Rs. 120 crore. In the past 10 years, the Institute has signed Memorandum of Understanding (MoU) with as many as 11 international and 12 national universities.



IIT Mandi Catalyst, first Technology Business Incubator in Himachal Pradesh, has helped over 75 startups since 2017 and is changing both the industry profile and entrepreneurial mindset in the state. So far, Catalyst has secured external funding of Rs. 24 crore from various funding agencies. Enabling Women of Kamand Valley (EWOK) is another innovative programme run by IIT Mandi, which focuses on imparting skills training to rural women to enable them to start village-scale businesses.

IIT Mandi has been ranked no. 31 in the Engineering Institutions Category in the [India Rankings 2020](#) released by National Institutional Ranking Framework, Ministry of Human Resources Development, Govt. of India.

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