

NANO-GOLD EMBEDDED IN THIN FILMS PAVES WAY FOR SELF-POWERED SENSORS & WEARABLE ELECTRONICS

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New ultrathin flexible film developed by researchers that can efficiently convert tiny temperature fluctuations into electrical signals, could support future smart photodetectors, low-grade heat harvesters, and advanced flexible electronic systems relevant to healthcare, environmental monitoring, and energy-efficient devices.

There is strong demand for lightweight, flexible, and low-power materials that can convert tiny thermal fluctuations into usable electrical signals for next-generation smart devices and autonomous sensors.

Earlier plasmonic-pyroelectric and PVDF composite systems have shown enhanced thermal-to-electrical conversion, but many such approaches rely on micron-thick devices or less controlled hybrid interfaces, which limits their suitability for thin, wearable, and low-power electronics.

There is a growing interest in combining plasmonic with pyroelectric polymers to create high-speed, low-power, self-powered devices that can respond to both thermal and optical stimuli.

Scientists from Institute of Nano Science and Technology (INST), Mohali, an autonomous institute of the Department of Science and Technology have demonstrated that embedding a minute amount of nanogold into a common ferroelectric polymer dramatically boosts its pyroelectric performance or the ability to generate electricity from changes in temperature.

The team led by Prof. Dipankar Mandal and collaborators including Sudip Naskar, engineered ultrathin films made from polyvinylidene fluoride (PVDF), a flexible polymer widely used in electronic and sensing applications.

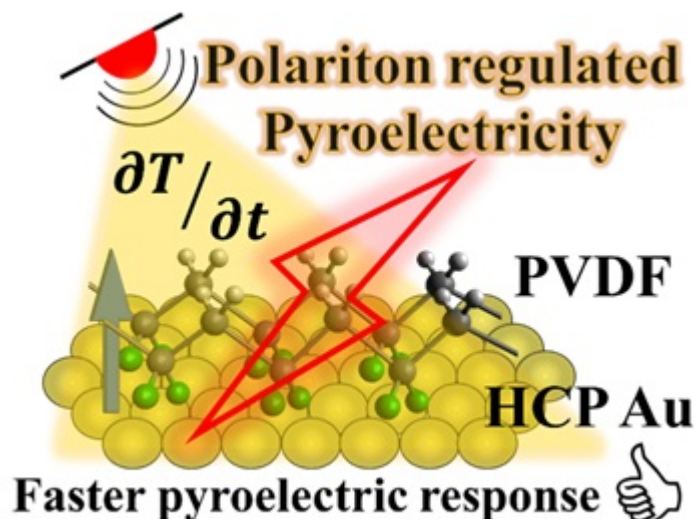


Fig: Gold polaritons regulate molecular dipoles of PVDF to enhance pyroelectricity, enabling a faster and more efficient thermal energy-harvesting response.

They built on known ferroelectric and film-forming properties of PVDF, and designed a low-dose in-situ nanogold strategy to understand how nanoscale gold–polymer interactions, dipole orientation, and confined plasmonic excitations can be used to tailor pyroelectric performance in very thin films.

By incorporating hexagonal nanogold particles into films thinner than 100 nanometres, the researchers achieved a nearly pure polar phase of PVDF with highly ordered dipoles, a structure essential for efficient pyroelectric behaviour.

The research published in *Adv. Funct. Mater.* establishes that a polymer-supported metastable hexagonal closed pack phase of gold nanoparticle and a highly ordered polar phase of PVDF matrix can be integrated into a robust 2D hybrid thin film, where plasmon-dipole-electron coupling act cooperatively to enhance pyroelectricity, dipole ordering, and broadband optical absorption.

By demonstrating efficient pyroelectric energy conversion in an ultrathin film over a small temperature fluctuation range of 294 to 301 K, this work addresses an important need for ambient-temperature thermal sensing and wearable energy harvesting technologies.

Publication link: (<https://doi.org/10.1002/adfm.202515437>).

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