Tech Xplore

Scientists develop novel amorphous flexible mini-inductor

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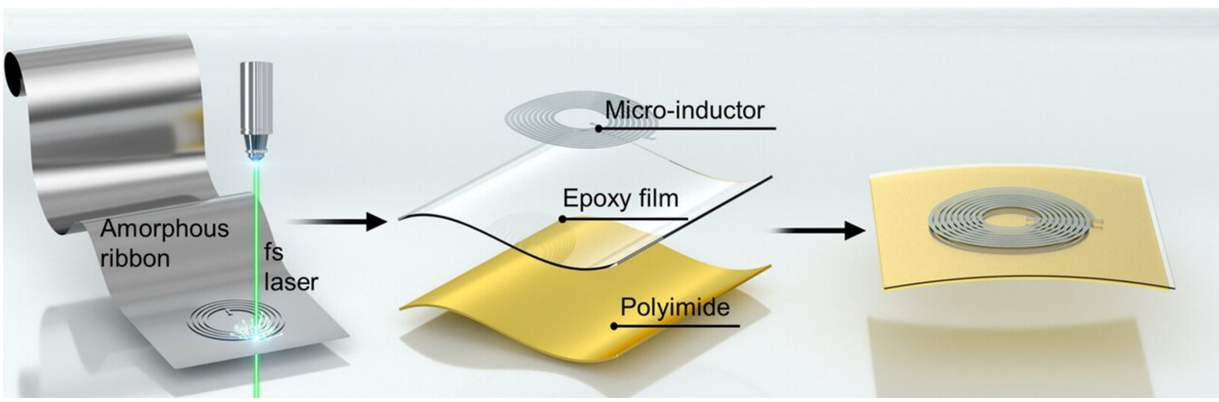

The design of amorphous flexible mini-inductor using femtosecond laser. Credit: NIMTE

A research team has developed a mini-inductor based on amorphous alloys that can achieve both excellent flexibility and high inductance. The study is published in *Advanced Functional Materials*.

As a key component in power conversion and signal processing, flexible mini-inductors with high energy density play an important role in improving device performance, reducing energy consumption and realizing device miniaturization. Conventional coils are mainly made of non-magnetic materials, which inevitably causes magnetic leakage. This magnetic flux leakage reduces the inductance density, which makes these inductors unsuitable for low-frequency applications.

To overcome this problem, Prof. Wang Junqiang's team from the Ningbo Institute of Materials Technology and Engineering (NIMTE) of the Chinese Academy of Sciences used Fe-based soft magnetic amorphous alloys as coil materials to fabricate an amorphous flexible mini-inductor, due to their excellent soft magnetic properties.

High-precision femtosecond laser ablation technology was used to precisely craft amorphous alloy ribbons without inducing the crystallization of the amorphous alloys, while maintaining their intrinsic mechanical excellence.

Compared with conventional inductors based on non-magnetic materials such as copper, the developed novel mini-inductor significantly reduces the magnetic leakage to less than 10^{-4} T, which greatly minimizes the interference between electronic components.

Thanks to the high permeability of the amorphous alloys, the inductance density of the device increases to about 280–390 nH/mm^2, which is about 10 times higher than that of conventional planar inductors.

In addition, the amorphous structure gives this flexible mini-inductor with excellent mechanical flexibility, which can be stretched by 300% of its original size. After 2,500 bending cycles at a 16-mm bending radius, the developed device can remain its performance with only a slight decay (less than 10%) in inductance value and quality factor, indicating its superior stability.

The amorphous flexible mini-inductor can adapt to various bending and folding application environments, due to its flexible design. It can achieve high inductance density in a very small volume to meet the miniaturization requirements of thin and light electronic products.

This study not only provides a new application scenario for amorphous soft magnetic alloys, but also sheds light on the material selection and device design of flexible electronics technology.

More information: Yanan Chen et al, Flexible Mini-Inductors with Ultra-High Inductance Density Directly Cut from Soft Magnetic Amorphous Alloys by Femtosecond Laser, *Advanced Functional Materials* (2024). DOI: 10.1002/adfm.202313355

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