激光直写柔性液态金属基湿度传感器

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柔性湿度传感器在先进制备方法以及人类健康检测、植物健康管理和非接触式人机界面的应用方面取得了较大的发展。柔性电容式湿度传感器因其可靠的湿度传感性能、低功耗和简单的结构设计而备受关注。

对于激光加工的柔性湿度传感器，典型的策略通常是激光直写电极后，在其表面沉积对湿度敏感的纳米材料，如碳或金属硫化物基材料。然而，这些湿度传感器的电极和敏感材料通常采用不同且复杂的加工工艺、多道工序制造而成。因此，开发基于薄膜的湿度传感器仍然需要一种简单快速的制造方法。

浙江大学柔性/生物电子制造实验室徐凯臣研究员课题组采用一步激光直写技术，研制了一种基于电容式测试原理的 Ga_2O_3/液态金属（LM）基湿度传感器。由于紫外激光的光热效应，Ga_2O_3 层包裹的 LM 颗粒（GWLM）可以选择性被烧结，并由绝缘带转化为导电带，其电阻率为 0.19 Ω·cm，而未处理区域则是响应湿度变化的传感层。在 95% 相对湿度下，该湿度传感器表现出高度稳定的性能、快速响应和恢复时间。利用这些优越的性能，Ga_2O_3/ LM 湿度传感器能够监测人体呼吸频率，以及不同生理状态下的手掌皮肤湿度，用于长时间可穿戴使用的医疗保健监测。

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Laser direct writing of Ga_2O_3/ liquid metal-based flexible humidity sensors

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Digital laser direct writing is a rapid and environmental-friendly manufacturing approach to generating functional micro/nano-structures or directly creating sensitive nanomaterials with high precision. Based on laser-matter interactions, via judiciously selecting the appropriate laser processing parameters, a variety of innovative flexible sensors.

The research group of Prof. Kaichen Xu from Flexible/Bioelectronic Manufacturing Laboratory, Zhejiang University proposed a wearable capacitive-type Ga_2O_3/liquid metal-based humidity sensor, which is demonstrated by a one-step laser direct writing technique.

Owing to the photothermal effect of laser, the Ga_2O_3-wrapped liquid metal nanoparticles can be selectively sintered and converted from insulative to conductive traces with a resistivity of 0.19 Ω·cm, while the untreated regions serve as active sensing layers in response to moisture changes. Under 95% relative humidity, the humidity sensor displays a highly stable performance along with rapid response and recover time. Utilizing these superior properties, the Ga_2O_3/liquid metal-based humidity sensor is able to monitor human respiration rate, as well as skin moisture of the palm under different physiological states for healthcare monitoring.

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