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ABSTRACT

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Insects and arachnids present efficient sensing mechanisms at microscales. Arachnids' trichobothria and insects' trichoid sensilla are hair-like sensing mechanisms that usually react to air flow or near-field low frequency sound [1-7]. By changes in the structure of the hair the sensilla can react to different phenomena, such as direct touch, acceleration, olfaction, or temperature [1, 8, 9]. The scorpions' trichobothria shows an ingenious mechanism, the hair shaft and the basal area have a big difference in stiffness. In some species the hair's Young's modulus is 20 times bigger than the one of the basal area [2, 10]. This allows for maximum mechanical efficiency, as the mechanical forces are not lost in bending the hair, but instead are deflected to the basal area, responsible for signal production. Research on sensors inspired by them has focused on using micro-electromechanical systems (MEMS), hence mainly involving semiconductors and conventional sensor producing techniques [11-13]. This brings with it the limitations of limited device layers and limited materials with mechanical properties considerably removed from their biological counterparts. With the advance of additive manufacturing (AM) techniques interest in producing sensors using polymers has increased. A significant challenge in this field is the formation of the electrode contacts. A common solution is a thin metallic film deposition however these presents issues with delamination and degradation of the electrical contact over successive cycles. Several conductive polymers for use in AM have increased in popularity and variety [14]. This project shows a bio-inspired sensor structure manufactured with AM, that allows the use of multiple polymer types applying a variation in stiffness along with conductive layers.

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