

## 3D Microbatteries for Swarm Sensing

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Small-scaled energy storage is a highly sought after technology for emerging miniaturised sensor systems. Yet despite the burgeoning interest in sensor miniaturisation, suitably small batteries that have sufficient energy to power these miniaturised sensor systems currently do not exist. The challenge facing current battery technologies is that the amount of energy that can be stored in a small-scaled battery is undesirably low. Reducing the size of a conventional battery has the undesirable effect of decreasing the energy available to the miniature sensor systems. Energy storage is thus considered to be a major roadblock in the trend towards sensor miniaturisation.

The development of miniaturised sensor systems is motivated by the potential implications in important application areas such as, but not limited to:

- Environmental monitoring – distributable autonomous and wireless sensors,
- Health monitoring – implantable micro-sensors,
- Security and defence – reconnaissance and surveillance (micro-drones).

CSIRO is developing such a miniaturised sensor system for swarm sensing. In this particular application insects are used as platforms to deploy thousands of miniature sensors. The technology has the potential to elucidate environmentally catastrophic events such as colony collapse disorder in honey bees and the incursion of fruit flies and other pest species. Environmental events such as these can have far-reaching implications for Australia's local and global agricultural food supply and ultimately people's livelihoods.

This presentation introduces the concept of swarm sensing and highlights the current research efforts that are focused on developing an innovative miniature battery that is capable of meeting the energy demands of the swarm sensing application. These miniature batteries overcome the problem of diminishing energy storage capacity for a reduced housing space or footprint by exploiting the use of complex 3D nanoarchitected electrodes to dramatically increase energy storage capacity. Accordingly, these nanoarchitected batteries are referred to as 3D microbatteries.<sup>[1]</sup>

[1] J. F. M. Oudenhoven, L. Baggetto, P. H. L. Notten, *Adv. Energy Mater.* 1 (2011) 10–33.