In-field explosives detection with fluorescent sensors

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Abstract
Organic semiconductor fluorescent sensors are highly sensitive for detecting explosives such as TNT. However, detecting trace amounts of explosives in field conditions is challenging. Recently we demonstrated preconcentration techniques using a polymer material to accumulate trace explosives over time, and subsequent thermal desorption exposes the sensor to a higher concentration. We have field tested the method for landmines using honeybees, and IEDs by swabbing.

Sensing explosives from the field

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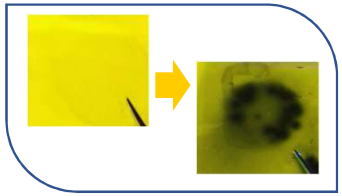
5. 
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Project Description

Preconcentration strips were fabricated using a commercial fluoropolymer and placed in the entrance of beehives. Honeybees foraging over a minefield picked up trace explosive molecules electrostatically via their body hairs and deposited these explosives on the strips as they returned to the hive. This resulted in a higher concentration of explosives on the strip which was subsequently thermally desorbed in the presence of an organic semiconductor fluorescent sensor. The sensor showed high fluorescent quenching, thus confirming the presence of buried mines. Several preconcentration materials are being explored for swabbing and preconcentrating explosive vapours from Improvised explosive devices (IEDs) to enhance sensitivity.

Key Results & Conclusions

- Preconcentrator polymer films are used to accumulate trace explosives in the field, before thermal desorption to a fluorescent sensor.
- An inexpensive, commercially available fluoropolymer is deployed to preconcentrate explosives collected by honeybees foraging across a minefield to confirm the presence of buried mines.
- Other sorbent materials have been optimised and characterised using dinitrotoluene (DNT) in lab conditions and will soon be tested in minefields and for IED detection.

[1] Gillanders et al,. https://doi.org/10.1016/j.scitotenv.2018.12.160