

A Leaf-Patchable Reflectance Meter for in situ Continuous Monitoring of Chlorophyll Content

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Abstract : Plant wearable sensors facilitate the real-time monitoring of plant physiological status. In situ monitoring of the plant chlorophyll content over days could provide valuable information on the photosynthetic capacity, nitrogen content, and general plant health. However, it cannot be achieved by current chlorophyll measuring methods. Here, a miniaturized and plant-wearable chlorophyll meter was developed for rapid, non-destructive, in situ, and long-term chlorophyll monitoring. This reflectance-based chlorophyll sensor with 1.5 mm thickness and 0.2 g weight (1000 times lighter than the commercial chlorophyll meter), includes a light emitting diode (LED) and two symmetric photodetectors (PDs) on a flexible substrate and is patched onto the leaf upper epidermis with a conformal light guiding layer. A chlorophyll content index (CCI) calculated based on this sensor shows a better linear relationship with the leaf chlorophyll content ($r^2 > 0.9$) than the traditional chlorophyll meter. This meter can wirelessly communicate with a smartphone to monitor the leaf chlorophyll change under various stresses and indicate the unhealthy status of plants for long-term application of plants under various stresses earlier than chlorophyll meter and naked-eye observation. This wearable chlorophyll sensing patch is promising in smart and precision agriculture.

Keywords : plant wearable sensors, reflectance-based measurements, chlorophyll content monitoring, smart agriculture

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