

Optical Fiber pH Sensor for Marine Microenvironments

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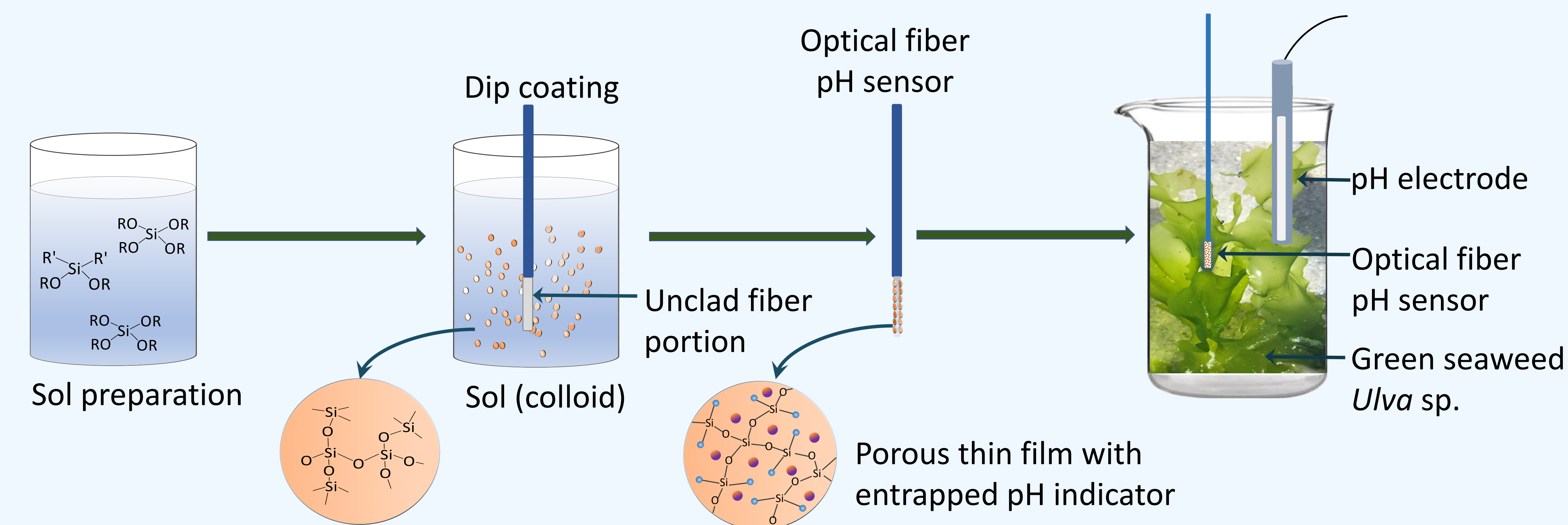
An **optical fiber pH sensor** was developed to **detect real-time metabolic-induced pH variations** in the **diffusion boundary layer (DBL)** and **canopy** of *Ulva* sp.¹

The **DBL** is an μm - to cm - thick microenvironment that directly surrounds many marine species. Studies have shown seaweed can biologically modify their local chemical microenvironment, leading to diel pH variation: pH increases during the day due to photosynthesis and decreases at night due to respiration.²

These photosynthetic marine species may be used as a refuge to ameliorate the effects of **ocean acidification** by elevating the pH of the surrounding seawater.³

This pH sensor for marine microenvironments contributes towards studies which facilitate the achievement of the UN Sustainable Development Goals - **SDG Target 14.3: Minimize and address the impact of Ocean Acidification.**

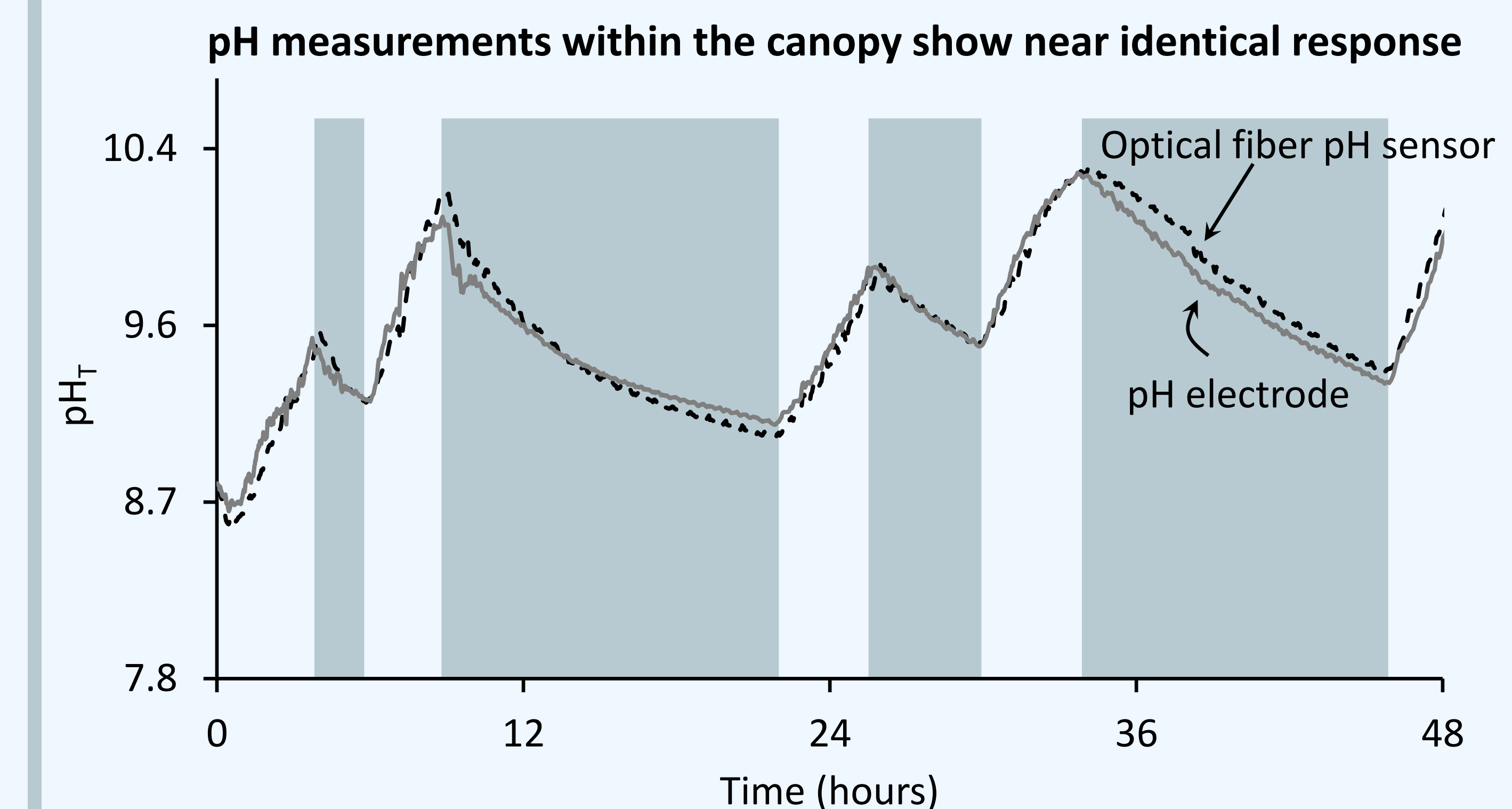
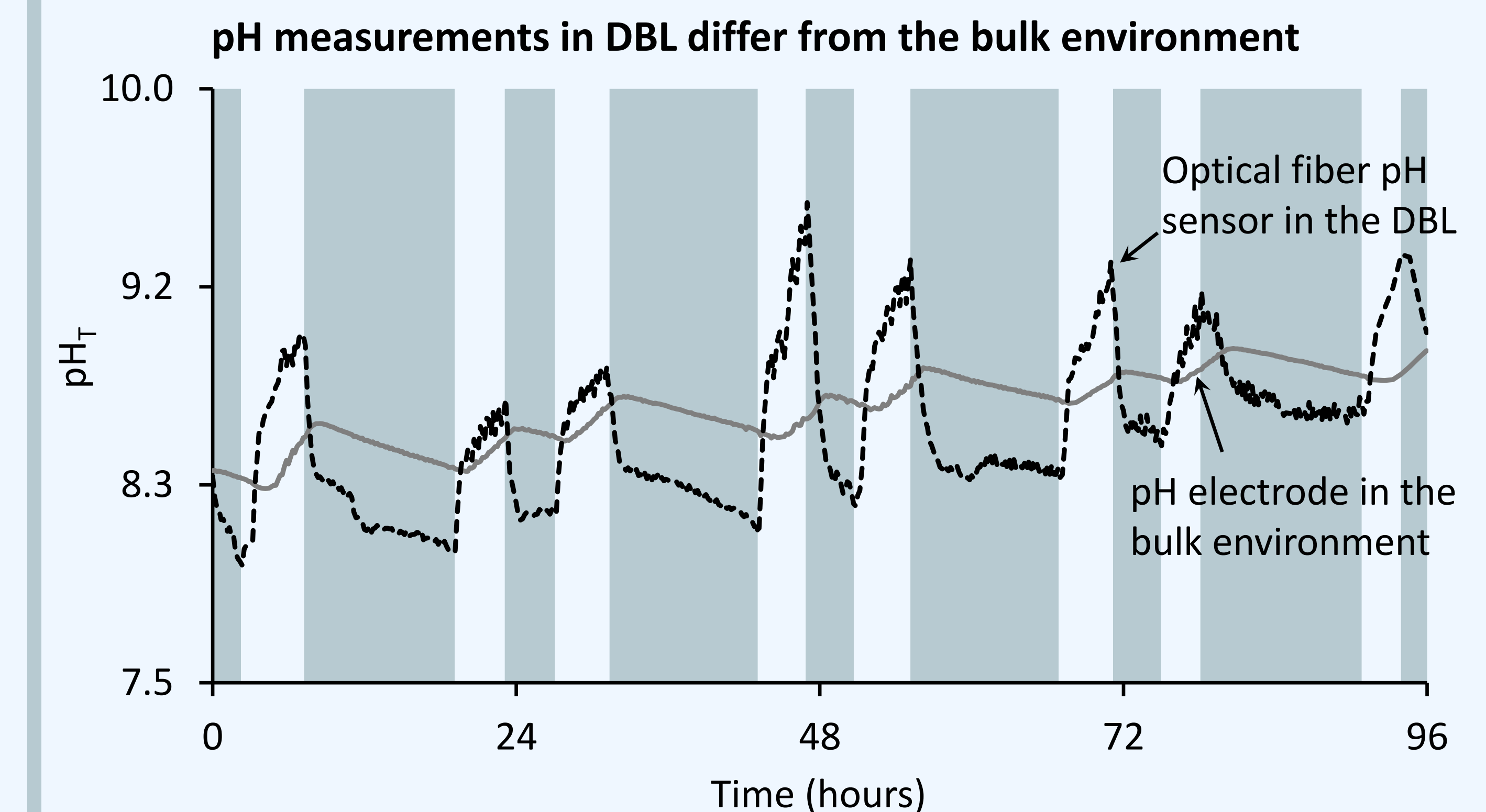
Fabrication of the optical fiber pH sensor



The pH sensing layer consists of pH indicator, **meta-cresol purple**, that was immobilized in a **sol-gel hybrid matrix**. The optimized porous matrix produced a homogeneous sensing surface which prevents dye leaching and allows H_3O^+ to interact with the pH indicator.

Sensor demonstrates metabolic induced pH changes in the seaweed DBL differs from the bulk seawater

Continuous pH measurement in the **canopy** and **DBL** of *Ulva* sp.
Shaded areas indicate periods of darkness



- Conforms to the **Global Ocean Acidification Observing Network “weather” measurement quality guideline** with precision of ~ 0.02 pH units (needed to meet **SDG 14.3**).
- Dynamic **pH_T range of 7.4 to 9.7** ($S=35$, $T=20^\circ\text{C}$) in seawater.
- Response time of 2.5 to 6.5 minutes.
- Usable lifetime of 7 days.
- Self-referencing approach:** does not require an external reference sensor.
- A simple sensor fabrication method, using a basic spectrophotometric system.
- Offers an **alternative to costly commercial sensors** for monitoring pH in marine microenvironments to meet **SDG 14.3**.

Current work

Improve pH sensor sensitivity by incorporating **fluorescence indicators**. A simplified time-domain dual-lifetime referencing (***t*-DLR**) measurement method is used to minimize interference from turbidity and the background chlorophyll in marine microenvironments.