Effects of Titanium dioxide nanoparticles on Sea Anemones, *Aiptasia pallida*

Titanium dioxide (TiO$_2$) is considered as an inert and safe material and has been used in many applications for decades. However, with the recent development of nanotechnologies, TiO$_2$ nanoparticles (TiO$_2$-NPs), with numerous novel and useful properties, are increasingly manufactured and used; and progressively being exposed to the environment. Due to their significantly higher specific surface area, TiO$_2$-NPs may exhibit physical and chemical properties that differ.

TiO$_2$-NPs are used to provide whiteness and opacity to products such as paints, plastics, papers, inks, foods such as powdered sugar, toothpastes and extensively used in cosmetic and skin care products such as sunscreen lotions. As the demand and production of TiO$_2$-NPs increase, so does their exposure to the marine ecosystems. TiO$_2$-NPs primarily affect organisms by causing oxidative stress in cells which in turn causes damage to their organelles and other cellular content including DNA.

The current rising global oceanic temperature is one of the main stressors affecting the animals of Class Anthozoa, corals and anemones. The animal being used in this study is the Sea Anemone *Aiptasia pallida* which houses symbiotic algae called zooxanthellae in their gastrodermal tissues. In exchange for providing the algae safe harbor and exposure to sunlight, the anemone receives oxygen and nutrients, the byproducts of the algae's photosynthesis. Overexposure to sunlight and high temperatures affect enzymes that aid in photosynthesis in algae creating reactive oxidants as byproducts that are harmful to the animal cells.

Studies with *Aiptasia* have contributed a significant amount of knowledge regarding Cnidarian biology, especially in the understanding of cnidarian-algal symbioses, a biological phenomenon crucial to the survival of corals and coral reef ecosystems. The dependence of coral reefs on the health of the symbiosis is illustrated by the devastating effects experienced by corals due to the loss of algal symbionts in response to environmental stress, a phenomenon known as coral bleaching.

This study is designed to understand the potential impacts of accumulation of TiO$_2$-NPs on cell physiology of sea anemones and their zooxanthellae and use the anemones as models of how TiO$_2$-NPs could also affect corals. Experiments will involve characterizing uptake of nanoparticles and what could be the combined effect of TiO$_2$-NPs and high temperatures on the anemone. Oxidative stress and toxicity will be measured by using the lipid peroxidation assay, measuring the total protein content in the animal tissue and micronucleus assay, which measures DNA damage. This study is important because the effects of TiO$_2$-NPs as pollutants have not been extensively researched in Class Anthozoa despite many of these species being subject to significant exposures of TiO$_2$-NPs, specifically via sunscreens. Moreover, these organisms are also experiencing elevated temperatures associated with global warming.