One Fish, Two Fish, Bright Fish, Clean Fish: Thermal Induced Biofluorescence of Fish Scale for Enhanced Chemical Adsorptivity

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The impact of environmental pollution has inspired sustainability through repurposing waste materials. Fish scales are one such material: often discarded by fish processing plants, fishmongers and consumers alike, their unique organic (collagen-based) and inorganic compositions presents the potential to enhance the physical properties of a common waste product. Using thermal treatment, the biofluorescence of the fish scale was enhanced, as well as its adsorption capability for use in chemical cleaning and pollutant removal. When heated on a hotplate, fish scales exhibit brighter blue fluorescence by a factor of 20 under UV excitation compared to non-heated fish scales. Photoluminescence analysis suggests the fluorescence comprises two main green and infra-red peaks. Cross-section imaging shows that the side of the fish scale facing towards the fish body, where the collagen core is located, is the side that fluoresces. FTIR analysis shows an increase in amides on heated fish scales. Thus, it is hypothesized that heating results in dehydration of collagen monomers and increased formation of amides. The adsorptive properties of fish scales were also explored for use in chemical cleaning of pollutants such as Rhodamine B, a common but toxic dye. Rhodamine B at a concentration as low as 10-7 M could be adsorbed and detected on the fish scales. Thermal treatment also greatly improved the effects of Rhodamine B cleaning from a 10-6 M solution. Such powerful enhancements displayed through simple thermal treatment show the tremendous potential of fish scales, both aesthetically and with practical chemical cleaning applications.

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