We describe the chromatophore granules as nanoscale photonic elements that contain proteins and fluoresce in the far-red.

**Results: Pigment Granules Fluoresce in the Far-Red**

- **Methods**
  - Chromatophore pigment granule extraction, isolation, and purification:
    - Pigment granules are spectrally different from free pigments in cephalopod chromatophores. Pigments in cephalopod chromatophores have been reported to be ommochromes, which are a class of small-molecule metabolites derived from tryptophan.
    - Unique protein release profiles occurring in response to increasing NaOH concentration were identified using Gene Expression Dynamics Inspector (GEDI) software.

- **Results**
  - Micro-photoluminescence spectroscopy was then used to characterize the optical properties of granules.
  - Variations in granule composition were measured as a function of increasing NaOH using MS/MS.
  - The sensitivity of proteins to NaOH was used to categorize and cluster the proteins that constitute the pigment granules.
  - Unique protein release profiles occurring in response to increasing NaOH concentration were identified using Gene Expression Dynamics Inspector (GEDI) software.

- **Discussion**
  - Tandem mass spectrometry used to analyze proteins that are released from granules upon denaturation:
    - Variations in granule composition were measured as a function of increasing NaOH using MS/MS.
    - The sensitivity of proteins to NaOH was used to categorize and cluster the proteins that constitute the pigment granules.
  - Unique protein release profiles occurring in response to increasing NaOH concentration were identified using Gene Expression Dynamics Inspector (GEDI) software.

- **Summary**
  - Our data suggest that adaptive coloration in *S. officinalis* is facilitated by the nanostructure and composition of the pigment granules.
  - An additional feature is luminescence, which, in addition to the already known absorbance, may contribute to the color intensity and hue of the expanded chromatophores.
  - These properties enable the cuttlefish to produce a wide variety of body patterns that function in signaling displays or camouflage.