Optical Properties of Cephalopod Skin

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Chameleons of the Sea

• Cephalopods: octopuses, squid, and cuttlefish

• Skilled at camouflage
  – Dynamic chromatophores

• Real-world applications?
  – Adaptive optical technology?
    • Dynamic camouflage
    • Filters or display screens
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My Project: An Inquiry Into a Unique Material

• Characterize skin optical properties
  – Optical absorption
  – Fluorescence spectra at a variety of excitation wavelengths
  – Photoluminescence used to look at skin’s structures
Preparation of Slides

• Remove skin from squid

• Pin down and bathe in artificial sea water

• Excise pieces that contain chromatophores

• Mount on slides with a few drops of artificial sea water and possibly KCl
Preparation of Slides

- Remove skin from squid
- Pin down and bathe in filtered sea water
- Cut out pieces that contain chromatophores
- Mount on slides with a few drops of filtered sea water and possibly KCl
Absorption of Squid Samples vs. Blanks

Absorption (A.U.) vs. Wavelength (nm)

- Squid Sample A + KCl
- Squid Sample B
- Artificial Sea Water (Blank)
- Artificial Sea Water + KCl (Blank)
Fluorescence with Excitation at 250nm

- **Squid Sample A + KCl**
- **Squid Sample B**
- **Artificial Sea Water (Blank)**
- **Artificial Sea Water + KCl (Blank)**
Fluorescence with Excitation at 300nm

- **Squid Sample A + KCl**
- **Squid Sample B**
- **Artificial Sea Water (Blank)**
- **Artificial Sea Water + KCl (Blank)**
Confocal Photoluminescence of Chromatophore

- Image created using a 532nm excitation laser
- Repeated with 550nm pulsed laser and attained similar results
Results

• Distinct absorption spectrum

• Clearly distinguishable emission patterns when excited at 300nm and 250nm

• Chromatophores appear to fluoresce much more than the rest of the skin when excited at 532nm and 550nm
What’s Next?

• More PL measurements using different excitation wavelengths

• Impacts of polarization, intensity, and interference of light, as well as of pressure

• Pigments

• Preservation
What I’ve Learned

• How to use a variety of instruments and techniques, including how to dissect a squid

• How important inventive critical thought is to research

• A mistake or dead end in research isn’t the end of the world

• The effort that goes into an innovative investigative project...

• ...and how rewarding results are
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Questions?
References

• **Roger Hanlon (Pictures on Slide 2-4)**
  
Are the Chromatophores Fluorescing?

- At first it looks like only the edges are bright, and that the center is dark
- Cross-section shows the center as being brighter than surrounding skin
- So yes, even the center is fluorescent