

# ADM Institute Seed Research Funding

## Progress Report (4/11-3/12)

Name	<u>Steve Eckhoff and Lynford Goddard</u>
Research Project	<u>Distributed Wireless Monitoring of Carbon Dioxide Concentrations in Grain Bins</u>
Department/s	<u>ABE and ECE</u>
Date	<u>4/29/12</u>

*Please provide a brief response below.*

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1. Please provide a brief statement of the project accomplishments thus far.

We constructed a mock-up storage bin (diameter=0.3m, height=3.4m) and evaluated the effectiveness of commercial wireless CO<sub>2</sub> sensors. Results showed that measuring CO<sub>2</sub> is more effective than measuring temperature for detection of corn spoilage. Further, elevated levels of CO<sub>2</sub> can be detected earlier by measuring with locally embedded sensors rather than by the conventional method of measuring CO<sub>2</sub> with external sensors in the headspace. Due to the high attenuation of wireless signals in corn, a fiber optic CO<sub>2</sub> sensor was investigated. We demonstrate an all-fiber thulium holmium co-doped fiber laser emitting at 2005 nm. By modulating the temperature of its fiber Bragg grating mirrors, we performed wavelength modulation spectroscopy and quantified CO<sub>2</sub> concentration down to 2% in a controlled optics lab environment.

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2. Has the project completed its objectives? Yes or No. If no, please describe the activities planned for the remainder of the project (4/12-3/13).

We have completed most of the objectives, but are working on reducing the fiber sensor cost and field testing it in the mock-up storage bin.

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3. Please attach (or provide a URL to products electronically available) work products that have been completed.

[R. Zhou, S. McKeown, B. Griffin, B. Amnueypornsakul, H. Huang, S. Eckhoff, D. Wasserman, and L. Goddard. "CO<sub>2</sub> sensing with a 2005 nm thulium holmium co-doped fiber laser," accepted to OSA Sensors Conference \(Jun 2012\).](#)

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