Kimmerling Group at MIT Problem Statement

At a weekly meeting of the research group, Dr. Anu Agarwal , Principal Research Scientist at MIT's Microphotonics Center asks Ph.D. candidate Peter Su to describe his research to Research Scientist Dr. Erik Verlage and Postdoctoral Researcher Dr. Samuel Serna.

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Anu: Peter, perhaps you can describe your research to the group and tell us what problems you have run into.

Peter: We're developing a very sensitive sensor to detect methane gas. It operates in the mid-IR at 3.3 microns. We're using integrated photonics so we can make it very small. Then when it gets into production we can use standard photolithography techniques that will make it inexpensive to mass manufacture.

Anu: How small a footprint are you talking about?

Peter: We want to put the methane-detecting waveguide in a 1 mm by 1 mm footprint. That's the size of the detector window in the device.

Erik: What materials are you using?

Peter: The waveguide is chalcogenide glass on a silicon dioxide substrate.

Samuel: What are the waveguide dimensions?

Peter: Our simulations indicate a 2 micron wide by 1 micron tall waveguide is optimal. From simulations of light coupling between adjacent waveguides it looks like if they're at least 10 microns apart we should be able to eliminate crosstalk. And the minimum bend radius is 50 microns.

Samuel: Wait! How exactly is the methane detected if the light is trapped in a waveguide?

Peter: That's an important question. As light propagates through a waveguide a little bit is hanging outside the waveguide…

Anu: That's the evanescent wave.

Peter: Right. And if there's methane present the evanescent wave absorbs some of the light. We measure how much light exits the chip so we know how much was absorbed. We use a second waveguide that's covered and isn't exposed to methane for reference.

Anu: So there are three problems to be solved: You need to couple light into the waveguide, allow it to interact with the methane gas, and then detect what exits at the other end.

Peter: Exactly!