CASE STUDY

SWIR Optical Filters for Pipeline Contaminant Detection

OVERVIEW

Chroma Technology collaborated with a sensor manufacturer in the oil and gas industry that was facing challenges in contaminant detection within pipelines. By designing custom short-wave infrared (SWIR) optical filters with precise bandwidths, cut-ons, and cut-offs — and optimizing coatings for durability — Chroma enabled the sensor to effectively isolate chemical signatures in field conditions. The result was a highly optimized, rugged sensor system that met the customer's performance and environmental demands.

- **Industry**: Oil and Gas
- **Application Area**: Pipeline monitoring for safety and contaminant detection
- **Technology Focus**: SWIR optical detection integrated into a compact sensor system

> *The customer required spectral precision and rugged performance in challenging field environments.*

CHALLENGE

The customer's sensor system demanded isolation of specific SWIR wavelengths associated with chemical contaminants, along with precise spectral characteristics including bandwidth, cut-on, and cut-off performance, all while remaining compatible with a compact instrument design and tight optical paths. Off-the-shelf filters were unable to meet this combination of spectral, mechanical, and environmental requirements.

SOLUTION

Chroma Technology leveraged its expertise in SWIR filter design to develop a customized solution. The team adapted existing high-performance SWIR technology and collaborated closely with the customer to refine and optimize the design for real-world instrument conditions. Chroma also provided guidance on instrument design adjustments to maximize performance.

> *This collaborative process ensured seamless integration into the customer's sensing platform.*

KEY FEATURES

High transmission
Maximum light throughput in target bands to preserve signal strength to the detector.

Deep out-of-band blocking
Tight rejection outside the passband, eliminating noise from adjacent wavelengths.

Sharp spectral transitions
Steep cut-on/off slopes for clean separation between passbands

Precise band placement
Exact wavelength positioning improves signal-to-noise and detection accuracy

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IMPLEMENTATION

1. Define target wavelengths based on contaminant signatures
2. Optimize coatings for beam shape and angle of incidence
3. Ensure compatibility with compact optical paths
4. Utilize sputter-coated filters for enhanced thermal and mechanical durability

RESULTS

- Improved system-level optimization through collaborative redesign
- Precise detection of contaminants at targeted SWIR wavelengths
- Successful validation testing with performance meeting customer expectations

CONCLUSION

This project demonstrates that early collaboration and iterative refinement are key to delivering optimized optical solutions. Rugged sputtered coatings proved essential for industrial durability, while precise spectral engineering enabled accurate detection of chemical signatures. The success of this engagement has laid the groundwork for continued partnership and future filter development.

Does your sensor application demand more than off-the-shelf optics?

Custom filter design starts with understanding your measurement challenge. Our optical engineering team can help you find the right optical filter to match your application.

START THE CONVERSATION