Double-Dynamic Interferometry in IR and Visible in Semiconductor Crystals

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ABSTRACT

We introduce a compact single-beam wave-front division interferometer, without stabilization for real-world applications. Using a 15 mW CW HeNe laser, we deflect a laser beam onto a mirror, which is connected to a function generator, that allow controlled phase modulation of the laser beam that illuminates the semiconducting crystal CdTe and ferroelectric crystal Sn2P2S6 (SPS).

THEORETICAL MODEL

\[
\frac{\partial N^+}{\partial t} = S I (N - N^+) - r n N^+
\]
\[
\varepsilon \varepsilon_0 \frac{\partial E}{\partial t} + \varepsilon \mu E + e D N = J
\]
\[
\vec{V}(\varepsilon \varepsilon_0 E) = e(N^+ - N - n)
\]

• Basic equations simplify for the model case of small contrast interference pattern:

\[
I(x,t) = I_0 \left[ \frac{m}{2} \exp(ikx - \beta \Omega t) + c.c. \right]
\]

• \( m \) is the modulation index (intensity contrast).
• \( k \) is the grating vector.
• \( I_0 \) is the average spatial intensity.
• \( \Omega \) is the frequency detuning between laser beams.

STATE OF THE ART AND TECHNOLOGY TRANSFER

Possible applications include: optical phase sensors, real-time, non-contact altitude determination, vibrometry, non-destructive testing with pulsed laser acoustics, biomedical acousto-photonic imaging, optical communication, and optical data storage (DoD). This work is supported through the DoD and the Department of the US Navy. It is under the RIA research for CenSSIS.

REFERENCES


SUMMARY AND FUTURE STUDIES

In summary, we have described single-beam double-dynamic interferometer, based on the fast ferroelectric semiconductor crystal SPS:Sb and the semiconductor CdTe. Fast response (milliseconds) was observed with low-power HeNe laser (632.8 nm, 15 mW) with phase modulated signals. This interferometer is compact, robust, and does not need mechanical stabilization.

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