All-silicon interferometer with multimode waveguides for temperature-insensitive filters and compact biosensors

We report a novel design of an all-silicon temperature-independent filter employing a Mach-Zehnder interferometer (MZI) with multimode waveguides. The two arms of the MZI have equal lengths and equal widths but propagate different modes having different effective indices to guarantee an optical path difference (OPD) but similar temperature-dependence to diminish any thermal shifts of the interference pattern. A temperature-independent MZI filter with only one channel is also proposed and experimentally demonstrated. Measurements verify the principle of operation and a low temperature sensitivity of ~20 to 10 pm/°C in the C-band for both MZI filters is achieved. The one-channel MZI structure is furthermore employed to achieve a compact sensor exhibiting a high sensitivity of 826 nm/RIU (refractive index unit).