

How vacuum gauges have to look like in the future?

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I have been asked to look into the crystal ball and predict the future. That is a difficult task, especially as there are a wide range of needs. One way is to extrapolate from where the industry stands today and follow certain mega trends.

Vacuum industry is a rather conservative industry. Most progress today is driven by the semiconductor industry. They need measurement instruments that are robust against process influences such as process contamination, temperature changes, as well have to possess low measurement uncertainty and be highly stable under repeatability and reproducibility conditions and they need to be integrated into their manufacturing supervision software. On the other end of the spectrum are interesting opportunities in research applications such as the gravitational wave observatories, that request measurement equipment to measure XHV pressures at cryogenic temperatures.

In the past vacuum gauges have become smaller and better performing mostly thanks to the miniaturization of electronics. Electronics still gets smaller and more performing allowing to do more signal processing and machine learning on the chip. With increased use of vacuum pressure sensors, the industry will move further away from artisanal manufacturing methods towards automated manufacturing and MEMS production. Optical measurement technologies are at this point too expensive for industry and the miniaturization is not yet as advanced, but eventually MOEMS technology may offer new perspectives.

The emerging quantum industry needs small sensors. In fact, our current man-sized vacuum technology is poorly adapted to the atomic sizes and numbers of atoms to be measured. The quantum industry needs extremely small sensors that do not influence the measurand (e.g., no heat or light emission) and can work at cryogenic temperature.

Industry wants standardized products that can be reliably manufactured at low cost and large unit volumes. Modularity offers to adapt to specific needs of the customer.

The ultimate gauge is small, single particle resolving, self-calibrating or absolute, low cost, process stable, gas type resolving, based on quantum effects and easy to integrate.