

AI in Manufacturing (AIM)

Custom AI manufacturing solutions

Fraunhofer USA develops AI solutions that combine machine learning, computer vision, and sensor data to monitor manufacturing processes as they happen, predict quality outcomes, and optimize process parameters in real time.

Approach

Fraunhofer USA evaluates data from a given process, whether that's camera and acoustic data from a weld, imaging from a materials synthesis process, or spectral data from a plasma, and acts on it at the point of production. The sensors and models differ from one process to the next, but the principle is the same: identify quality problems in-line while the part, coating, or material is still being made and defects can be corrected. Because inference runs locally on the equipment rather than in the cloud, manufacturers keep production data on site. Built on a modular architecture, our solutions integrate with existing manufacturing equipment and scale across products, processes, and production lines.

Results

Manufacturers see better quality, higher productivity, lower costs, and full process coverage through in-process monitoring. The three cases on page 2 show what that looks like in practice: more than 50% less manual quality verification in welding, a coating model trained on just 27 hours of process data, and diamond growth predicted up to 20 hours in advance. Fraunhofer USA adapts this platform to what your process needs.

Example Industries

- Battery and EV manufacturing
- Semiconductor materials
- Automotive manufacturing
- Industrial coatings

Applications Include

- Quality prediction
- In-line process monitoring
- Real-time parameter optimization
- Predictive maintenance
- Production workflow optimization

Joining

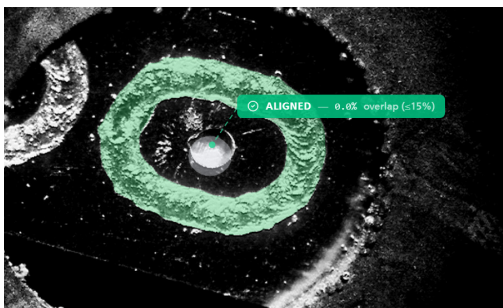
Catching hidden defects in every weld

Sample-based inspection only checks a fraction of welds, so defects like incomplete penetration or lack of fusion can go undetected until a part fails downstream or in the field. Fraunhofer USA's AI-based monitoring system inspects 100% of welds in-line, combining visual, acoustic, and process data to catch defects in real time, before a defective part moves downstream or ships. In an earlier resistance spot welding project at a major automaker, Fraunhofer USA's AI inspection reduced manual quality verification by more than 50%.

- Identifies defects in milliseconds
- Catches hidden and subsurface defects

50%

Reduced Manual Quality Verification Effort for Resistance Spot Welding



Real-time AI analysis of laser weld

Surface Engineering

Correcting phase drift in thin-film coatings

Thin-film coating processes are nonlinear and tend to drift out of the film phase an application requires. Fraunhofer USA's physics-aware neural network (PANN) monitors the deposition state in real time and holds the process in the regime its target phase needs, using a physics-aware model that trains on a comparatively small dataset.

- Keeps an unstable coating process in the phase a target application needs
- Trained on just 27 hours of process data

27 hours

Training Data Required



Magnetron sputtering plasma deposition

Materials Growth

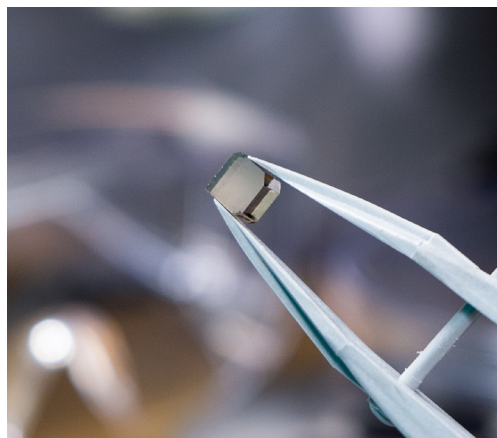
Predicting defects in CVD crystal growth

Diamond crystal growth is a highly nonlinear process, which makes real-time process control difficult and limits both crystalline quality and yield. Defects that form partway through a growth run typically aren't visible until the wafer is finished, by which point the batch can't be corrected. Fraunhofer USA developed AI algorithms that predict a wafer's growth state up to 20 hours in advance, using a camera and thermal imager retrofitted onto existing growth tools.

- Retrofits onto existing growth tools
- Opens a path toward fully automated diamond wafer synthesis, with higher crystalline quality and yield

20 hours

Future Defect Prediction



Single crystal diamond

Partner With Fraunhofer USA

Fraunhofer USA is a 501(c)(3) nonprofit research and development organization with more than 30 years of experience applying advanced manufacturing, artificial intelligence, software systems, and materials science to industry and government challenges. Contact us to discuss your needs.

Learn More

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