Hitachi Digital Services

Case Study

Illuminating Precision: Transforming Semiconductor Quality with AI-Powered Materials Informatics

Objective

- The focus is on enhancing the efficiency of **developing photoresist materials** and their **quality assurance processes.**
- **Photoresist materials** are crucial for semiconductor circuitry, with **polymers, photosensitive agents, and solvents** being key components.
- **Bridge defects** serve as an important quality indicator, detectable through **electron microscopy**.

Challenges

1. **Exploration of Experimental Conditions**: Transitioning from reliance on human expertise to **machine learning** to optimize material composition and process conditions, aiming to streamline experiments and reduce costs.
2. **Quality Evaluation of Microcircuit Patterns:** Replacing the inefficient and subjective manual inspection of semiconductor patterns with a more consistent and efficient method.

.Approach

- **Hitachi's data scientists** employed AI for image analysis to quantify bridge defects and data analysis to suggest optimal experimental conditions.
- A **SaaS-type Analytics Platform** was introduced for routine quality evaluations, enabling the use of AI for analyzing electron microscope images.

Outcomes

- A **statistical approach** minimized the number of experiments and manual labor, enhancing efficiency.
- The **Analytics Platform** transformed the quality inspection process by quantifying bridge defect assessments, reducing human judgment reliance, and decreasing evaluation times.

Analysis

This case study describes the benefits of applying AI in a technical field, emphasizing the shift from qualitative to quantitative methods in quality assessment. The significant reduction in evaluation time—from **20-30 seconds per image** to processing **100 images in 5-6 minutes**—is a testament to the efficiency gains achieved through AI. This not only boosts throughput but also alleviates the workload for researchers, marking a substantial advancement in the semiconductor industry.

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