

Literature Review: GANs for Microstructure Synthesis

1. Virtual Microstructure Design for Steels Using Generative Adversarial Networks

- **Authors:** Lee Jin-woong, Nam Hoon Goo, Woon Bae Park, Kee-Sun Sohn
- **Published:** *Engineering Reports*, 2021
- **Summary:** This paper explores the application of GANs to generate virtual microstructures of steels, aiming to establish a quantitative microstructure-property relationship model.
- **Link:** [Virtual Microstructure Design for Steels Using Generative Adversarial Networks](#)

2. Deep Convolutional Generative Adversarial Network for Generation of Computed Tomography Images of Discontinuously Carbon Fiber Reinforced Polymer Microstructures

- **Authors:** J Blarr et al.
- **Published:** *Scientific Reports*, 2024
- **Summary:** The study presents a deep convolutional GAN that generates realistic CT images of carbon fiber reinforced polymers, demonstrating its potential in material science imaging.
- **Link:** [Deep Convolutional Generative Adversarial Network for Generation of Computed Tomography Images](#)

3. Microstructure Generation via Generative Adversarial Network for Heterogeneous, Topologically Complex 3D Materials

- **Authors:** T Hsu et al.
- **Published:** *JOM*, 2021
- **Summary:** This research implements a GAN framework to generate 3D microstructures of solid oxide fuel cell electrodes, highlighting its effectiveness in capturing complex material topologies.
- **Link:** [Microstructure Generation via Generative Adversarial Network for Heterogeneous, Topologically Complex 3D Materials](#)

4. A Conditional Generative Model for Predicting Material Microstructures from Processing Methods

- **Authors:** Akshay Iyer, Biswadip Dey, Arindam Dasgupta, Wei Chen, Amit Chakraborty

- **Published:** *arXiv*, 2019
- **Summary:** The paper proposes a conditional GAN to model the relationship between processing conditions and material microstructures, facilitating the prediction of microstructure evolution.
- **Link:** [A Conditional Generative Model for Predicting Material Microstructures from Processing Methods](#)

5. Development of Process-Structure Linkage Using Conditional Generative Adversarial Networks

- **Authors:** Not specified
- **Published:** *Metallurgical and Materials Transactions A*, 2024
- **Summary:** This study develops a methodology for robust 3D Statistically Equivalent Virtual Microstructures (SEVMs) and micromechanical models of complex multi-modal microstructures.
- **Link:** [Development of Process-Structure Linkage Using Conditional Generative Adversarial Networks](#)

6. Generative Adversarial Network (GAN) Enabled Statistically Equivalent Virtual Microstructures (SEVM) for Modeling Cold Spray Formed Bimodal Polycrystals

- **Authors:** B Murgas et al.
- **Published:** *npj Computational Materials*, 2024
- **Summary:** The paper develops a methodology for robust 3D SEVMs and micromechanical models of complex multi-modal microstructures that are difficult to construct by conventional synthetic microstructure builders.
- **Link:** [Generative Adversarial Network \(GAN\) Enabled Statistically Equivalent Virtual Microstructures \(SEVM\) for Modeling Cold Spray Formed Bimodal Polycrystals](#)

7. Synthesizing Controlled Microstructures of Porous Media Using Generative Adversarial Networks and Reinforcement Learning

- **Authors:** Not specified
- **Published:** *Scientific Reports*, 2022
- **Summary:** This paper proposes a novel deep learning method that can synthesize realistic three-dimensional microstructures with controlled structural properties using the combination of GANs and actor-critic reinforcement learning.
- **Link:** [Synthesizing Controlled Microstructures of Porous Media Using Generative Adversarial Networks and Reinforcement Learning](#)

8. Physics-Aware Deep Generative Models for Creating Synthetic Microstructures

- **Authors:** R Singh et al.
- **Published:** *Materials Science and Engineering: R: Reports*, 2018
- **Summary:** The study introduces novel techniques that use GANs to generate microstructures, ensuring that the generated images respect the distribution of certain physical invariances.
- **Link:** [Physics-Aware Deep Generative Models for Creating Synthetic Microstructures](#)

9. Using Deep Learning to Capture Gravel Soil Microstructure

- **Authors:** B Zhu et al.
- **Published:** *Scientific Reports*, 2025
- **Summary:** This approach enables the reconstruction of 3D digital samples of gravel soil, allowing for the generation of specific microstructure realizations, including complex pore characteristics.
- **Link:** [Using Deep Learning to Capture Gravel Soil Microstructure](#)

10. Microstructure Synthesis Using Style-Based Generative Adversarial Networks

- **Authors:** D Fokina et al.
 - **Published:** *Physical Review E*, 2020
 - **Summary:** This work considers the usage of StyleGAN architecture for the task of microstructure synthesis, aiming to generate realistic-looking microstructures while preserving their properties.
 - **Link:** [Microstructure Synthesis Using Style-Based Generative Adversarial Networks](#)
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