# Microbial synthesis of stereoirregular PHB

A novel fermentation-based technology enables the production of stereoirregular poly(3-hydroxybutyrate) (PHB), a biodegradable polymer with significantly improved material and processing properties. By enabling direct microbial incorporation of both (R)- and (S)-3-hydroxybutyrate monomers from sustainable carbon sources, this platform combines the performance benefits of chemically synthesized PHB with the scalability, cost efficiency, and sustainability of industrial biotechnology.

IP RIGHTS
PCT filed
2025

## Modified Escherichia coli strain synthesizes stereoirregular PHB

The material properties of the stereoirregular PHB can be tuned to specific applications by adjusting the (S)-3-hydroxybutyrate fraction during fermentation. The engineered pathway allows flexible polymer synthesis from sustainable carbon sources (e.g. side streams from agriculture, aquaculture and forestry, C1 molecules like methane or methanol), via a single monomer intermediate simplifying process control and scale-up compared to traditional polyhydroxyalkanoate copolymer production.

01 Significantly improved thermal processability (Figure 1)
02 Enhanced recyclability (Figure 2)
03 Optical transparency
04 Streamlined production

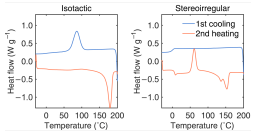



**Figure 1: Thermal behavior of microbial PHB during differential scanning calorimetry.**

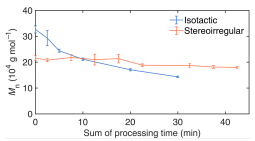



**Figure 2: Molar mass decomposition of microbial PHB during thermal processing.**

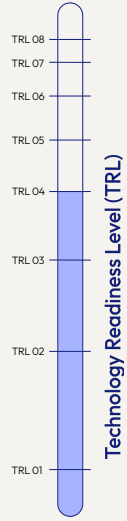
REFERENCES:
Haslböck et al., (2018)
Mayer et al., Biomacromolecules (2026)

### CHALLENGE

PHB is a biodegradable alternative to petroleum-based plastics, but its broad commercial adoption is limited by poor material properties. Natural microbial PHB is strictly (R)-isotactic, causing crystallinity and brittleness. PHB's high melting point overlaps with its thermal degradation temperature, causing molecular weight degradation during thermal processing and complicating recycling. While chemical synthesis can produce more flexible, stereoirregular PHB, it remains industrially uncompetitive.

### INNOVATION

This new microbial synthesis route enables the direct production of stereoirregular PHB via fermentation in recombinant microorganisms. Overturning the long-held assumption that PHA synthases are strictly stereoselective, this technology successfully incorporates both (R)- and (S)-3-hydroxybutyrate monomers into the polymer chain. This breakthrough bridges the gap between the superior material properties of chemically synthesized PHB and the cost-effective, sustainable scalability of microbial synthesis.




**01** Basic principles observed · **02** Technology concept formulated · **03** Experimental proof of concept · **04** Technology validated in lab · **05** Technology validated in relevant environment · **06** Technology demonstrated in relevant environment · **07** System prototype demonstrated in operational environment · **08** System complete and qualified

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