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Production of Polyhydroxyalkanoates by Bacterial Fermentation

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Polyhydroxyalkanoates (PHAs) are energy and carbon storage material intracellularly accumulated by numerous microorganisms, and are drawing much attention as a candidate for completely biodegradable plastic and elastomer material. Fermentation strategies that allow production of PHAs with high productivity and high yield have been developed for several wild-type and recombinant bacterial strains. Dry cell weight of greater than 200 g/L with PHA content exceeding 75% could be achieved by employing a couple of microorganisms. PHA productivity as high as 5 g PHA/L-h could be achieved by employing an appropriate cultivation strategies. Strain development and fermentation strategies that allowed highly efficient production of PHA will be discussed.

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Differential Scanning Calorimetric Study of Poly(3-hydroxyoctanoate)Inclusions in Bacterial Cells

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Medium chain length polyhydroxyalkanoates, MCL PHAs, produced by bacteria as inclusion bodies or granules were analyzed in situ by differential scanning calorimetry(DSC) without isolating them from cells. The kinetic DSC study of PHA granules containing mostly 3-hydroxyoctanoate units(PHO) in Pseudomonas putida BM01 cells showed that the polymer chains within the granules existed in an amorphous state, but they crystallized after dehydration under freeze-drying condition(below - 50℃) followed by annealing at ambient temperature. In this manner, PHO within cells readily crystallized within 24 hr at room temperature, which was much faster than this polymer isolated by solvent extraction. This observation suggests that the polymer chains within the cellular granules may be well organized. The DSC endothermic peak areas for the room temperature annealed polymers in cells were directly proportional to the amount of polymer in the cell, and the results from this type of quantitative analysis were essentially identical to those obtained by gas chromatographic and gravimetric analysis of the polymers. X-ray diffraction data for the freeze-dried, whole cells and for the isolated, kinetically stabilized PHO polymer showed that the two types of PHO samples have a similar crystal structure, but the granular PHO chains exhibited a better side-chain packing indicating higher crystallinity.