

材料化学工程与纳米技术

机械活化对玉米淀粉结晶结构与化学反应活性的影响

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摘要 采用搅拌球磨机对玉米淀粉进行机械活化, 用X射线衍射仪、差示扫描量热仪、扫描电子显微镜及粒度分析仪等考察了机械活化对玉米淀粉结晶结构、热特性、颗粒形貌及粒度变化的影响。并将不同活化时间的玉米淀粉在相同条件下与乙酸酐进行酯化反应及与丙烯酰胺进行接枝共聚反应, 通过研究机械活化对酯化反应取代度、接枝共聚反应接枝率与接枝效率的影响规律来探讨机械活化对玉米淀粉化学反应活性的影响。结果表明, 机械活化预处理能显著提高玉米淀粉酯化反应的取代度及接枝共聚反应的接枝率与接枝效率, 说明机械活化能有效地提高玉米淀粉的化学反应活性。其原因是玉米淀粉在机械活化过程中其结晶结构与颗粒形貌均受到破坏, 结晶度降低, 最终由多晶态转变成非晶态。并随活化时间的延长, 糊化温度及糊黏度下降, 流动性增强, 从而使反应试剂的扩散阻力下降, 易于扩散到淀粉分子中参与反应。

关键词 [玉米淀粉](#) [机械活化](#) [结晶结构](#) [化学反应活性](#) [乙酸酯化](#) [接枝共聚](#)

分类号

Mechanical activation effects on crystal structure and chemical reaction activity of maize starch

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Abstract

Maize starch was mechanically activated by a stirring-type ball mill. The effects of mechanical activation on crystal structure, thermal properties, granule shape and particle size of maize starch were examined by means of X-ray diffraction, differential scanning calorimetry, scanning electron microscope and particle size analyzer. Moreover, mechanically activated maize starch (MAMS) with different activation times was acetylated with acetic anhydride and graft-copolymerized with acrylamide under the same experimental conditions. The mechanical activation effects on chemical reaction activity of maize starch were investigated by analyzing the influence of mechanical activation on degree of substitution (DS) of esterification and grafting rate (G) and grafting efficiency (GE) of graft copolymerization. The results indicated that the DS, G and GE of MAMS were higher than that of native starch, and showed obviously enhanced chemical reaction activity of maize starch by mechanical activation. The crystal structure and compact granule surface of maize starch were destroyed by mechanical activation, and the crystallinity decreased from polycrystalline to amorphous. With increasing activation time, the gelatinization temperature and pastes viscosity of MAMS decreased and its fluidity was enhanced. As a consequence, the resistance of reagents diffusing into starch solution would be reduced and it was easier to diffuse into starch intramolecule.

Key words [maize starch](#) [mechanical activation](#) [crystal structure](#) [chemical reaction activity](#) [esterification](#) [graft copolymerization](#)

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