有机化学 2006 26 (11): 1557-1561 ISSN: 0567-7351 CN: 31-1320/06

研究论文

单加成环丙烷富勒烯膦酸酯衍生物的合成与电化学性能

杨新林*,[a]，乔新歌[a]，朱张广[a]，程福永[b]，朱鹤孙[b]，范楼珍[c]

([a]北京理工大学生命科学与技术学院 北京 100081)
([b]北京理工大学材料科学研究中心 北京 100081)
([c]北京师范大学化学系 北京 100875)

收稿日期 2005-10-24 修回日期 网络版发布日期 2006-10-26 接受日期 2006-5-26

摘要 在$Mn(OAc)_3$•$2H_2O$催化下, C_{60}分别和亚甲基二膦酸四乙酯、氰基亚甲基膦酸二乙酯或乙氧羰基亚甲基膦酸二乙酯在氯苯中回流, 生成3个单加成环丙烷富勒烯膦酸衍生物$C_{60}C(R)PO(OEt)_2$ [**1**, R＝$PO(OEt)_2$; **2**, R＝COOEt; **3**, R＝CN]. 与以前报道的Bingel反应法相比, 该方法副产物少并且缩短了反应时间. 采用循环伏安法发现**1**, **2**的还原电位相对于C_{60}发生负移, 而**3**的还原电位相对于C_{60}却正移40 mV, 表明引入象氰基一样具有很强吸电子能力的取代基团, 可以改善富勒烯球的电化学性能, 合成电子接受能力较强的富勒烯衍生物.

关键词 单加成环丙烷富勒烯膦酸衍生物 合成 电化学性能 循环伏安法

分类号

Synthesis and Electrochemical Properties of Mono- methano[60]fullerene Organophosphonates

YANG Xin-Lin*,[a],QIAO Xin-Ge[a],ZHU Zhang-Guang[a],CHENG Fu-Yong[b]
ZHU He-Sun[b],FAN Lou-Zhen[c]

([a] *School of Life Science and Technology, Beijing Institute of Technology, Beijing 10081*)
([b] *Research Center of Materials Science, Beijing Institute of Technology, Beijing 100081*)
([c] *Department of Chemistry, Beijing Normal University, Beijing 100875*)

Abstract In the presence of manganese(III) acetate dihydrate [$Mn(OAc)_3$•$2H_2O$], the reaction of [60]fullerene with tetraethyl methylenediphosphonate, diethyl cyanomethylphosphonate or diethylphosphonoacetic acid ethyl ester in refluxing chlorobenzene afforded the corresponding methano[60]fullerene organophosphonates $C_{60}C(R)PO(OEt)_2$ [**1**, R＝$PO(OEt)_2$; **2**, R＝COOEt; **3**, R＝CN], respectively. This reaction produced fewer by-products and needed less reaction time. Therefore it is superior to the Bingel reaction for the preparation of compounds **1**, **2** and **3**. In addition, compared with C_{60}, compounds **1** and **2** had negative shifts but **3** had a posive shift of 40 mV in reduction half-wave potentials ($E_{1/2}$) determined by cyclic voltammetry. These data indicate that the introduction of electro-attracting groups such as cyano-group to fullerene ball might improve the electrochemical properties and synthesize fullerene derivatives with strong electron-accepting ability.

Key words mono-methano[60]fullerene organophosphonate synthesis electrochemical property cyclic voltammetry

DOI:

通讯作者 杨新林 xlyang@bit.edu.cn