不同修飾處理對奈米碳管的缺陷與抗氧化性的影響

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摘要

奈米碳管(Carbon nanotube)為碳的同素異形體，是碳原子以 sp^2 雜化軌道組成的六角型蜂巢狀中空管柱體，具有強烈的電子親和力與吸收自由基的效果。奈米碳管的表面很容易以化學或物理的方式修飾，可以依造需求改變奈米碳管的性質。奈米碳管具有很好的抗氧化活性，如清除 DPPH、ABTS 與氫氧自由基等能力較 BHA、穀胱甘肽佳，若將奈米碳管與具有抗氧化性的化合物結合則可以進一步的增強抗氧化性，增強幅度可達數倍。除了抗氧化物提供的抗氧化性以外，與奈米碳管結合的抗氧化物也會影響奈米碳管的結構，進而增加奈米碳管本身的抗氧化性，造成協同效應，當維生素 E 與奈米碳管以物理吸附的方式結合時，在高溫的情況下維生素 E 會釋放自由基破壞奈米碳管的結構，產生缺陷，這些缺陷使奈米碳管能接收更多的自由基，提升奈米碳管的抗氧化性。利用物理破壞的方式也能影響奈米碳管的缺陷程度，經過球磨處理的奈米碳管利用拉曼光譜儀測試後發現其缺陷程度會上升，在清除 DPPH 自由基的實驗中可以觀察到球磨處理奈米碳管的抗氧化性也呈現上升的情形，證明奈米碳管的缺陷程度與其抗氧化性有正相關性，而微波處理則會導致奈米碳管的碳原子重排，修補缺陷，導致抗氧化性下降。多層奈米碳管因為多了一層石墨烯層，在相同的合成條件下會產生較多的缺陷，因此其吸收自由基的效果會較單層奈米碳管高。奈米碳管的抗氧化性質目前已經在高分子材料中有許多的研究，是一個新穎、高效率且容易修飾的抗氧化物質

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