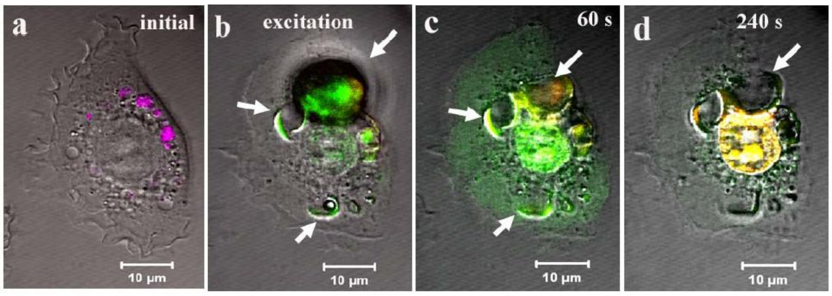
物理所陳洋元教授研究團隊發表之論文「以金奈米棒之表面激發電漿殺死癌細胞之光熱療法之研究」被選入本院 99 年度重要研究成果

本所陳洋元研究員與陳正龍博士的研究團隊，利用雷射光激發金奈米棒之表面電漿，研究其產生的光熱效應(photothermolysis)，如何殺死癌細胞。該項研究成果除已發表在**生醫材料期刊(Biomaterials)**，也被選入本院 99 年度重要研究成果專刊。研究發現，細胞的穿孔及胞膜瞬間破裂是由於金奈米棒的光熱效應所引發局部高溫氣化膨脹，並導致癌細胞破裂死亡。此一癌細胞內的空泡破裂動態過程(Cavitation dynamic)取決於激發能量的大小，且是細胞膜穿孔或瞬間嚴重瓦解的原因。同時發現，癌細胞內金奈米棒的數量越多，殺死癌細胞所需的能量越小。此一研究可了解奈米材料在癌細胞光熱解作用的機制與過程，並有助於光熱療法應用在臨床上。



上圖為金奈米棒接受光能量密度約 93 mJ/cm2 刺激時,對乳腺癌細胞(EMT-6)所造成的光熱效應過程。

P.S. ：相關研究已受邀撰寫為「Nanomedicine and Cancer」專書的一章 ISBN 978-1-57808-727-3; September 2011 by Science Publisher (USA)。

The research on 「In situ real-time investigation of cancer cell photothermolysis mediated by excited gold nanorod surface plasmons」was selected as one of 2010 representative works of Academia Sinica

The work by the research team of Dr. Yang-Yuan Chen and Dr. Cheng-lung on photothermolysis of living EMT-6 breast tumor cells triggered by gold nanorods (AuNRs) has been published in **Biomaterials, 31,** 4104-4112 (2010)**.** It was also selected as 2010 representative research of Academia Sinica. The morphology and plasma membrane permeability of the cells were key indicators to the phenomena. AuNRs with an aspect ratio of 3.92, and a longitudinal absorption peak at 800 nm were synthesized with a seed mediated method. The nanorods surfaces were further modified with polystyrenesulfonate (PSS) for biocompatibility. The prepared nanorods displayed excellent two-photon imaging. *In situ* real-time results revealed cavities internal to the cells were created from thermal explosions triggered by AuNRs localized photothermal effect. The cavitation dynamic is energy dependent and responsible for the perforation or sudden rupture of the plasma membrane. The energy threshold for cell therapy depended significantly on the number of nanorods taken up per cell. For an ingested AuNR cluster quantity N~10-30 per cell, it is found that energy fluences E larger than 93 mJ/cm^2 led to effective cell destruction in the crumbled form within a very short period. As for a lower energy level E=18 mJ/cm^2 with N ~60-100, a non-instant, but progressive cell deterioration, is observed. These results provide useful information on evaluating and improving the performance of Au NRs-based photothermal therapy.
Releated materials will appear in the book chapter of「Nanomedicine and Cancer」(ISBN 978-1-57808-727-3) published by Science Publisher (USA)。

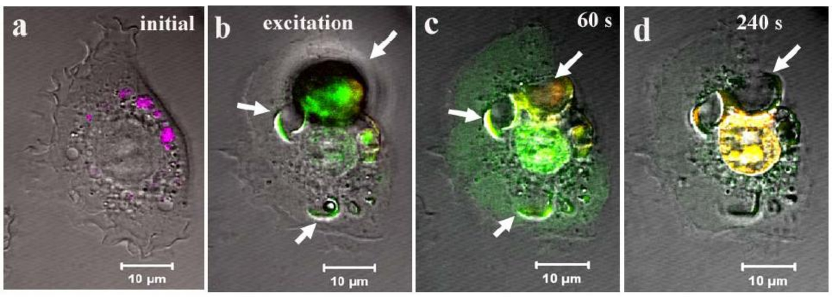


Figure: Photothermolysis of the EMT-6 tumor cell triggered by AuNRs under 93 mJ/cm^2