# IgA response and protection following nasal vaccination of chickens with Newcastle disease virus DNA vaccine nanoencapsulated with $Ag@SiO_2$ hollow nanoparticles

Kai Zhao [1, 2, *], Guangyu Rong [2, 4], Yan Hao [2], Lu Yu [2, 4], Hong Kang [2], Xin Wang [2], Xiaohua Wang [2], Zheng Jin [3], Zhiyu Ren [3, *], Zejun Li [4, *]

[1] School of Biological Science and Technology, University of Jinan, Jinan 250022, China

[2] Key Laboratory of Microbiology, School of Life Science, Heilongjiang University, Harbin 150080, PR China;

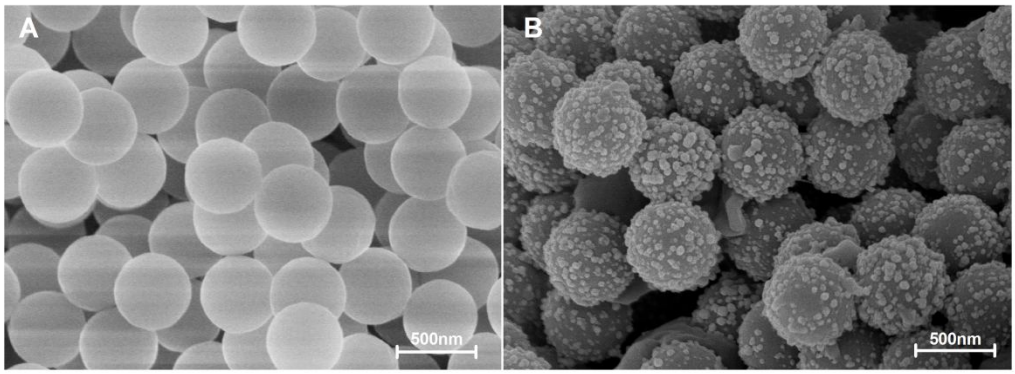
[3] Key Laboratory of Functional Inorganic Material Chemistry, Ministry of Education, Laboratory of Physical Chemistry, Key Laboratory of Chemical Engineering Process & Technology for High-efficiency Conversion, School of Chemistry and Materials Science, Heilongjiang University, Harbin 150080, PR China;

[4] Department of Avian Infectious Disease, Shanghai Veterinary Research Institute, Chinese Academy of Agricultural Sciences, Shanghai 200241, PR China;

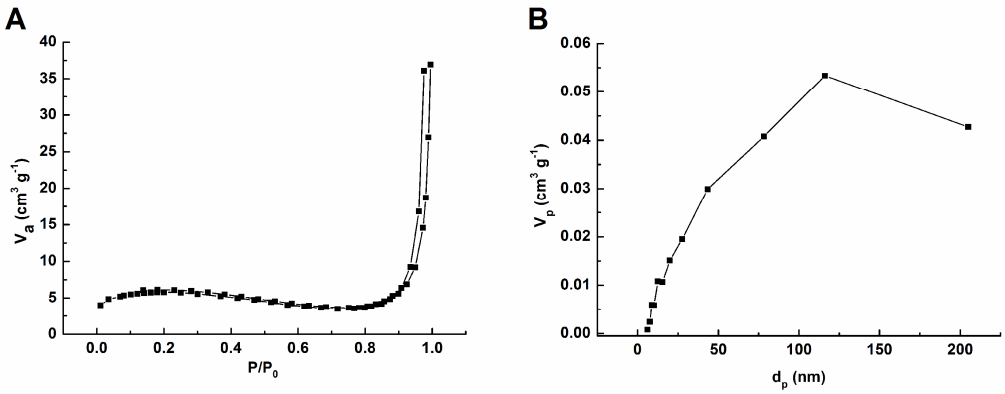
Running title: $Ag@SiO_2$ nanoparticles as an efficient vaccine delivery carrier

* Correspondence: Kai Zhao, Tel: +86 531 82767361, Fax: +86 531 89736818, E-mail: zybin395@126.com; Zhiyu Ren, Tel: +86 0 18946066093, Fax: +86 451 51997166, E-mail: zyren@hlju.edu.cn; Zejun Li, E-mail: lizejun@shvri.ac.cn

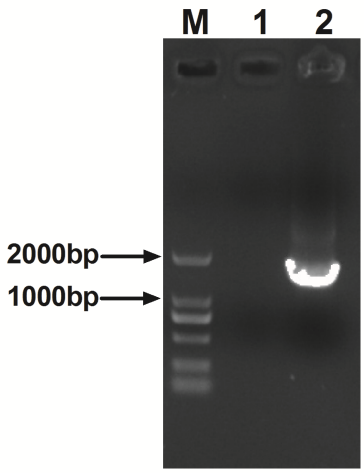
**Supplementary Information**



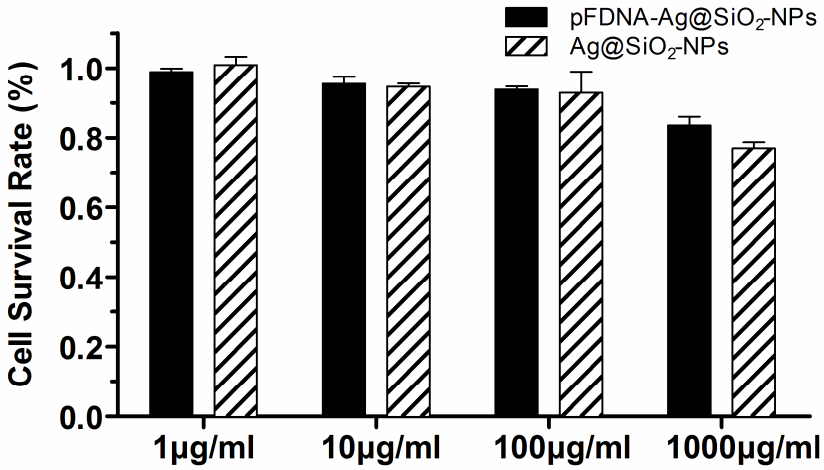

**Supplementary Figure 1. Scanning electron microscopy micrograph of (A) PS microspheres and (B) PS@Ag.**




**Supplementary Figure 2. (A) $N_2$ adsorption–desorption isotherms and (B) the corresponding BJH pore size distribution plots of samples Ag@$SiO_2$ hollow nanoparticles.**




**Supplementary Figure 3. The PCR amplification of F genes. Lane 1 shows F genes amplification sequences of the plasmid pVAX Ⅰ-F (o) DNA treated by DNase Ⅰ; Lane 2 shows F genes amplification sequences of the pFDNA-Ag@$SiO_2$-NPs treated by DNase Ⅰ; M: DNA Marker DL 2000.**




**Supplementary Figure 4. *In vitro* cytotoxicity analysis of CEF cells survival ratio treated with different concentrations of pFDNA-Ag@$SiO_2$-NPs and Ag@$SiO_2$ hollow nanoparticles. Error bar represented means of three independent experiments.**