Supporting Information for

Two-Dimensional Nano-Coating Enables Orthopedic Implant for

Bimodal

Song Wang,[‡ab] Chunyan Duan,[‡c] Weizhong Yang,[‡a] Xiangyu Gao,[a] Jiacheng Shi,[a]

Jianping Kang,[b] Yi Deng,[*ade] Xiao-Lei Shi,[fg] and Zhi-Gang Chen,[fg]

[a]College of Materials Science and Engineering, School of Chemical Engineering, Sichuan University, Chengdu 610065, China.

[b]Department of Spine Surgery, the Affiliated Hospital of Southwest Medical University, Luzhou 646000, China

[c]School of Basic Medical Sciences, Southwest Medical University, Luzhou 646000, China

[d]State Key Laboratory of Polymer Materials Engineering, Sichuan University, Chengdu 610065, China

[e]Department of Mechanical Engineering, The University of Hong Kong, Hong Kong SAR, China

[f]Centre for Future Materials, University of Southern Queensland, Springfield Central, Queensland 4300, Australia

[g]School of Mechanical and Mining Engineering, University of Queensland, Brisbane, Queensland 4072, Australia.

*Corresponding Authors

Assoc. Prof. Yi Deng

Email: dengyibandeng@scu.edu.cn

Captions of figures and tables

Fig. S1. (a) AFM image of 2D nano-coating; (b) XPS analysis of SPEEK-GO-pDA.

Fig. S2. SEM observation of bone-like apatite nodules formation on 2D nano-coatings after immersion in SBF solution.

Fig. S3. Optical images and X-ray images of rabbit femurs with different SPEEK implants after 8-week post-implantation.

Fig. S4. 2D micro-CT images of different implants after 4 and 8 weeks of *in vivo* implantation. The newly-regenerated bone around implants is labeled by red.

Fig. S5. ESR spectra of ROS generation from different coatings on SPEEK samples for different irradiation times.

Table S1. Ion concentrations of 1X SBF (mM).

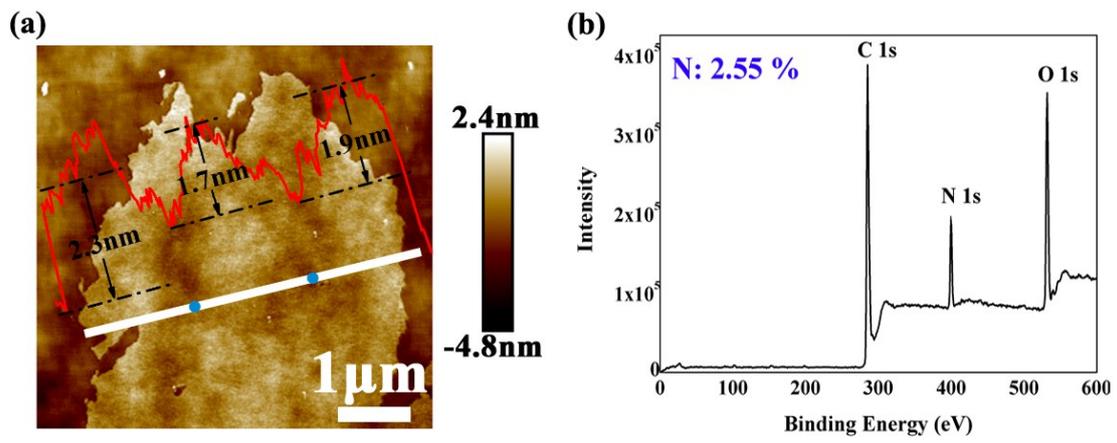**Table S2.** Primer sequence (5′-3′) for the quantitative RT-PCR.

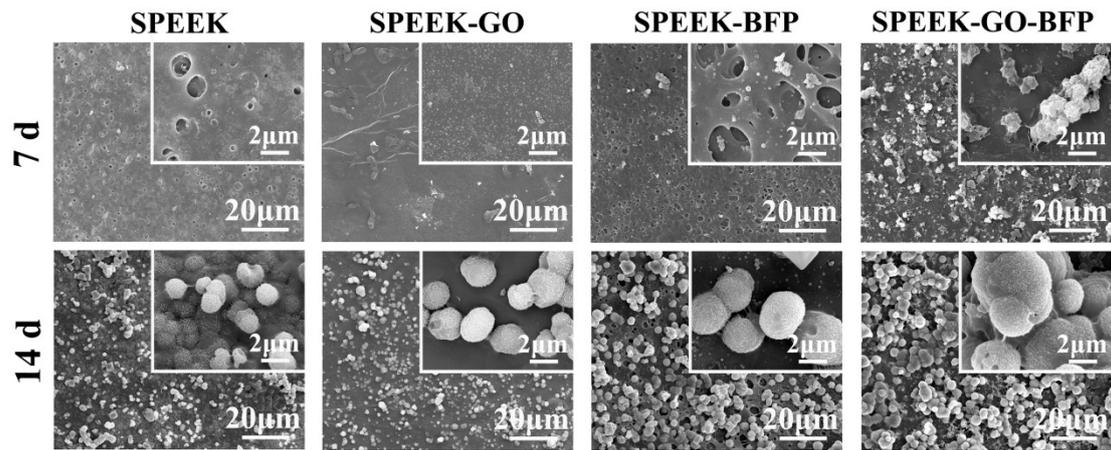**Fig. S1.** (a) AFM image of 2D nano-coating; (b) XPS analysis of SPEEK-GO-pDA.

Fig. S2. SEM observation of bone-like apatite nodules formation on 2D nano-coatings after immersion in SBF solution.

Fig. S3. Optical images and X-ray images of rabbit femurs with different SPEEK implants after 8-week post-implantation.
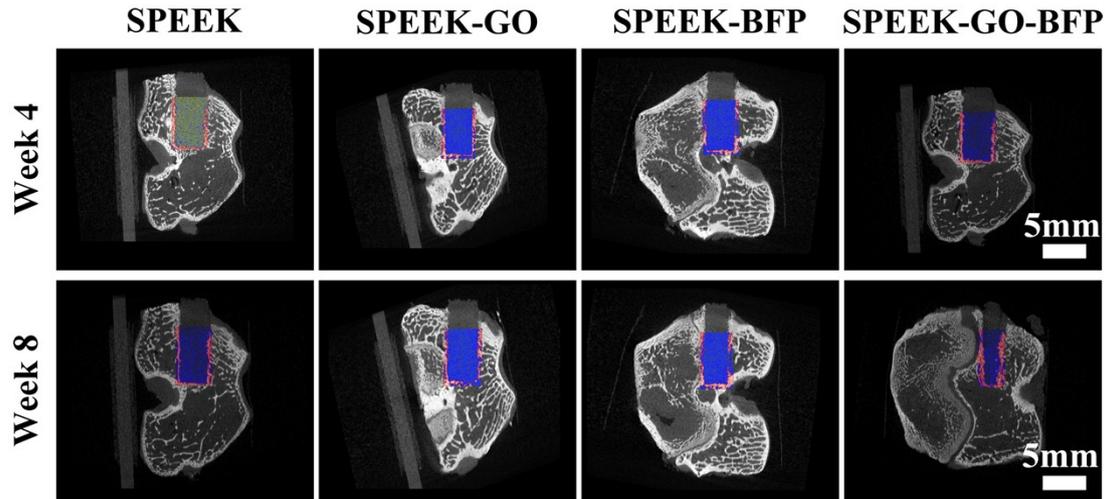
Fig. S4. 2D micro-CT images of different implants after 4 and 8 weeks of *in vivo* implantation. The newly-regenerated bone around implants is labeled by red.
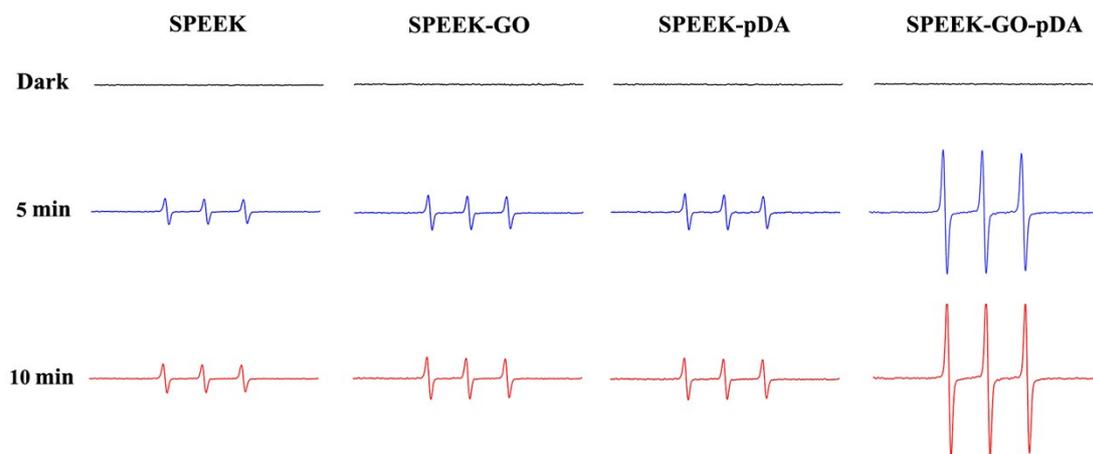
Fig. S5. ESR spectra of ROS generation from different coatings on SPEEK samples for different irradiation times.

Table S1. The concentrations of inorganic salts for 1X SBF preparation.

Inorganic name	Concentration (mM)
NaCl	136.8
NaHCO$_3$	4.2
KCl	3.0
K$_2$HPO$_4$•3H$_2$O	1.0
MgCl$_2$•6H$_2$O	1.5
CaCl$_2$	2.5
Na$_2$SO$_4$	0.5

Table S2. Primer sequence (5′-3′) for the quantitative RT-PCR.

Name	Forward primer	Reverse primer
GAPDH	CGACAGTCAGCCGCATCTT	CCAATACGACCAAATCCGTTG
RUNX2	AGGAATGCGCCCTAAATCACT	ACCCAGAAGGCACAGACAGAAG
OCN	GAACAGACAAGTCCCACACAGC	TCAGCAGAGTGAGCAGAAAGAT
COL1A1	GCTCCTCTTAGGGGCCACT	CCACGTCTCACCATTGGGG