**PEI-Silica Hybrid Coating for Controlling Biodegradation Rate of Magnesium**

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**Statement of Purpose:** Magnesium (Mg) and its alloys have been widely studied as implant materials due to their bioresorbable properties**.** Moreover, because of the rapid corrosion of Mg, various coating materials were studied. Polyetherimide (PEI) has been introduced as a good protective coating layer because of the good adhesion with Mg [1, 2]. However, PEI is so inert in an aqueous environment that the degradation of Mg is too slow and also it has relatively low bioactivity. To control the degradation rate, nano-scale bioresorbable silica was hybridized with PEI by sol-gel method. Moreover, bioactivity of PEI can be improved because silica has excellent bioactivity [3].

**Methods:** For the reagent of silica sol Tetramethylorthosilane (TMOS), distilled water, hydrochloric acid (HCl) was mixed at a volume ratio of 5 : 1 : 0.02. PEI solution was prepared by dissolving PEI in NMP. Silica sol was mixed with PEI solution by 0, 15, 30 and 45 vol% of silica. Hybridized solution was spin-coated on Mg substrate. Coated specimen was dried at 70 °C. SEM was used to observe surface morphology and the thickness of the coating layer. Corrosion behavior was evaluated by monitoring the amount of hydrogen gas evolved after immersing the specimen in simulated body fluid (SBF) solution at 37 °C (n = 4). Initial cell adhesion of pre osteoblast cell (MC3T3-E1) was observed with confocal laser scanning microscope (CLSM) after 12 h. Cell proliferation and differentiation was evaluated by DNA assay after 3d (n=4) and ALP activity assay after 10 d (n = 4) respectively.

**Results:** Fig.1 shows the surface morphologies and the coating thickness of PEI-silica hybrid coating layer. Hybrid coating layers were formed without any cracks. Thickness of hybrid coating layer was about 400nm. Fig. 2 shows the amount of $H_2$ gas evolved after immersing the specimen in SBF solution. Average volume of evolved $H_2$ gas for bare Mg and PEI-silica coated with 0, 15, 30 and 45 vol% of silica were 28.9, 0.3, 0.7, 1.1 and 3.1 ml respectively. PEI coating layer restrains the rapid $H_2$ generation of bare Mg and degradation can be controlled with the ratio of silica. Fig. 3 (a) and (b) shows the CLSM image of attached cell morphology. The cells were stably attached on coated Mg and furthermore the cells well spread out and flattened on the PEI-silica hybrid coating layer than those on the pure PEI coating layer. DNA amount and ALP activity of MC3T3 cell were evaluated after culturing on bare Mg and PEI-silica coated Mg for 3d and 10d, respectively (Fig. 3 (c)). Mg with hybridized coating layer had higher level of proliferation and differentiation. By hybridizing bioactive silica with PEI could enhance the bioactivity.

**Conclusions**: PEI-silica hybrid was coated uniformly without any cracks on Mg substrate by spin-coating method. It was possible to control the corrosion rate of Mg with the ratio of silica in PEI coating layer. Furthermore bioactivity was improved by hybridizing silica with PEI. This PEI-silica coated Mg can be used for orthopedic application due to its good bioactivity and controllable degradation rate.

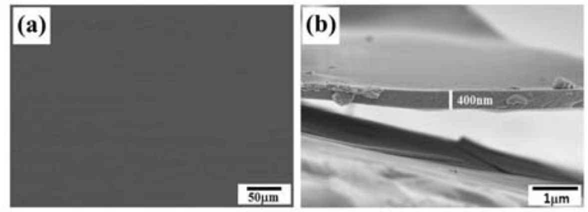


**Figure 1.** SEM image of (a) surface morphology and (b) thickness of PEI-silica hybrid coating layer

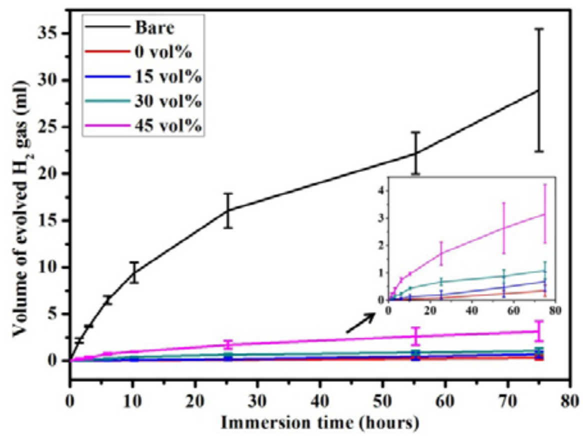


**Figure 2.** Evolved $H_2$ gas after immersing bare Mg and PEI-silica coated Mg with different volume contents of silica (0, 15, 30, 45 vol%) in SBF. The inset graph shows the same data without bare specimen

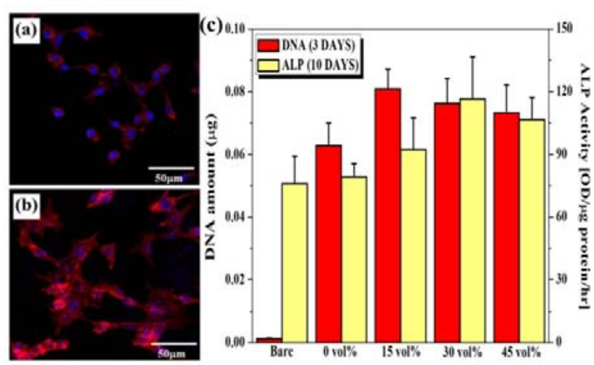


**Figure 3.** CLSM image of cell attached morphology after 12 h on Mg coated with (a) pure PEI and (b) PEI-silica hybrid, and (c) DNA amount and ALP activity of MC3T3 cell on bare Mg and PEI-silica coated Mg with different volume contents of silica after 3 days and 10 days respectively

**REFERENCES**

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