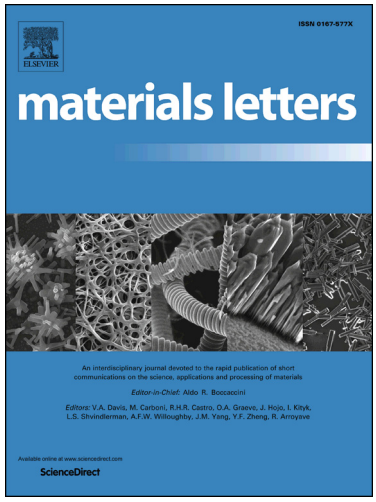


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# A simple way of modulating *in vitro* angiogenic response using Cu and Co-doped bioactive glasses

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## ABSTRACT

The copper and cobalt-doped bioactive glasses (BGs) from the basic $SiO_2$–$CaO$–$P_2O_5$ system, differing in the $CaO/SiO_2$ molar ratios, were produced using sol-gel method. The *in vitro* angiogenic response of human fibroblasts and umbilical vein endothelial cells (HUVECs) on Cu-BGs and Co-BGs was investigated. The incorporation of Cu and Co into BGs significantly enhanced vascular endothelial growth factor secretion from fibroblasts. Cu-BGs and Co-BGs extracts might facilitate the migration of HUVECs and the self-assembled network formation after 3 days of culture without basement membrane matrix, demonstrating strong angiogenic activity. The results show that cellular response was correlated with Cu and Co release rate which, in turn, was affected by the $CaO/SiO_2$ molar ratios, indicating new opportunities for controlling the release rate of therapeutic ions from BGs.

**KEYWORDS:** Biomaterials; Sol-gel preparation; Bioactive glasses; Transition metals; Human fibroblasts; Human umbilical vein endothelial cells;

## 1. INTRODUCTION

The angiogenesis plays an essential role in the effective treatment of bone defects, especially the large ones. Therefore, developing multifunctional biomaterials that can promote bone formation (osteogenesis) and stimulate formation of the new blood vessels (angiogenesis) simultaneously, is one of the greatest challenges of bone tissue engineering (BTE) [1,2]. Bioactive glasses (BGs) are some of the most