Perancangan biosensor berbasis piezoresistive mikrokantilever : pengukuran dan simulasi = Designing piezoresistive microcantilever based on biosensor : measurement and simulation

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Abstrak

Aplikasi mikrokantilever sebagai biosensor mulai banyak dipelajari dalam dunia kesehatan, biologi, kimia dan lingkungan hidup. Pada riset ini dilakukan perancangan biosensor dengan menggunakan piezoresistive mikrokantilever. Aktivitas riset meliputi pembuatan rangkaian wheatstone bridge sebagai detektor obyek, simulasi perubahan frekuensi resonansi berbasis Persamaan Euler-Bernoulli Beam sebagai deteksi keberadaan obyek, dan simulasi gerak mikrokantilever dengan menggunakan software COMSOL Multiphysics 3.5. Jenis piezoresistive mikrokantilever yang digunakan adalah seri NPX1CTP004 SII Nanotechnology dengan panjang 110 µm, lebar 50 µm, dan tebal 1 µm. Massa mikrokantilever adalah 12,815 nanogram (sudah termasuk massa receptor-nya). Contoh obyek yang dideteksi adalah bakteri, dimana massa untuk satu bakteri diasumsikan 0,3 picogram. Saat terdeteksi, satu massa obyek bakteri akan menyebabkan nilai defleksi sebesar 3,05355x10-11 m dan nilai frekuensi resonansi sebesar 118,90 kHz, sedangkan untuk empat obyek bakteri akan menyebabkan nilai defleksi sebesar 3,05445x10-11 m dan nilai frekuensi resonansi sebesar 118,68 kHz. Dari data tersebut terlihat bahwa bertambahnya massa bakteri akan menyebabkan naiknya nilai defleksi dan turunnya nilai frekuensi resonansi.
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Abstract
Diverse applications of microcantilevers in the field of sensors have been explored by many researchers, such as in medicine, biological, chemistry, and environmental monitoring. This research designs a biosensor using piezoresistive microcantilever. The activities consist of designing Wheatstone bridge circuit as object detector, simulation of resonance frequency shift based on Euler Bernoulli Beam equation, and deflection simulation using COMSOL Multiphysics 3.5 software program. The piezoresistive microcantilever type is NPX1CTP004 SII Nanotechnology series with length 110 µm, 50 µm width, and thickness of 1 µm. Microcantilever mass is 12.815 nanograms (include the mass receptor). The sample of object in this research is bacteria. One bacteria mass is assumed to 0.3 picograms. When detected, the mass of one bacterium will cause deflection of 3,05355x10-11 m and resonance frequency value of 118,90 kHz. Besides, for the mass of four bacterium will cause deflection of 3,05445x10-11 m and resonance frequency value of 118,68 kHz. From these data show that increasing the mass of bacteria will increasing the deflection value and reducing the value of resonance

frequency.;Diverse applications of microcantilevers in the field of sensors have been explored by many researchers, such as in medicine, biological, chemistry, and environmental monitoring. This research designs a biosensor using piezoresistive microcantilever. The activities consist of designing Wheatstone bridge circuit as object detector, simulation of resonance frequency shift based on Euler Bernoulli Beam equation, and deflection simulation using COMSOL Multiphysics 3.5 software program. The piezoresistive microcantilever type is NPX1CTP004 SII Nanotechnology series with length 110 µm, 50 µm width, and thickness of 1 µm. Microcantilever mass is 12.815 nanograms (include the mass receptor). The sample of object in this research is bacteria. One bacteria mass is assumed to 0.3 picograms. When detected, the mass of one bacterium will cause deflection of 3,05355x10-11 m and resonance frequency value of 118,90 kHz. Besides, for the mass of four bacterium will cause deflection of 3,05445x10-11 m and resonance frequency value of 118,68 kHz. From these data show that increasing the mass of bacteria will increasing the deflection value and reducing the value of resonance frequency.