Pengembangan sistem pendinginan komponen mikroelektronik hemat energi melalui pengelolaan aliran termal berbasis teknologi jet sintetik = Development of microelectronics cooling system components energy efficient through flow thermal management technology based synthetic jet

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Abstrak

[ABSTRAK
Perkembangan industri elektronik untuk produk berkinerja tinggi yang ditandai dengan munculnya piranti elektronika berukuran minimalis serta menggunakan daya yang rendah memerlukan sebuah sistem pendinginan yang handal dan efisien sehingga mampu beroperasi secara optimum. Pada penelitian ini teknologi yang digunakan untuk mendinginkan komponen piranti elektronika tersebut menggunakan jet sintetik yang memanfaatkan gerakan membran secara kontinyu dengan menghasilkan cincin vortex untuk mempercepat proses perpindahan panas. Penelitian yang dilakukan pada study ini bertujuan untuk mencari nilai frekuensi, jenis gelombang eksitasi, serta bentuk orifis jet sintetik yang menghasilkan performa pendinginan yang baik untuk model jet sintetik impinging, mencari pengaruh jarak tumbukan (impact) jet sintetik impinging terhadap laju perpindahan panas konveksi untuk proses pendinginan, mencari model cavity jet sintetik impinging dan jet sintetik cross flow yang memiliki kehandalan dalam proses pendinginan. Penelitian ini dikerjakan menggunakan pendekatan komputasional dan eksperimental. Pada pendekatan komputasional digunakan software CFD (computational fluid dynamics) yang mendefinisikan kondisi batas jet sintetik dengan asumsi dinding bergerak (moving wall) dan model turbulensi k-omega SST (Shear Stress Transport). Kemudian model uji eksperimental menggunakan model jet sintetik tipe impinging dan model jet sintetik tipe cross flow. Model-model tersebut memiliki perbedaan dalam hal arah aliran jet sintetik terhadap media yang akan didinginkan berupa heatsink. Modus eksitasi yang dipergunakan untuk menghasilkan aliran jet sintetik tersebut menggunakan sinyal listrik berupa gelombang sinusoidal, square dan triangular dengan variasi frekuensi 80 Hz, 120 Hz dan 160 Hz. Sinyal listrik tersebut dihasilkan oleh sweep function generator. Hasil yang diperoleh dari kajian komputasional dan eksperimental tersebut memberikan informasi bahwa jet sintetik mampu memberikan efek pendinginan pada objek yang akan didinginkan. Parameter dari variasi frekuensi eksitasi jet sintetik dan arah aliran jet sintetik memberikan efek yang beragam dalam hal pendinginan. Dari hasil penelitian yang dilakukan tersebut diperoleh modus eksitasi yang paling baik menggunakan gelombang eksitasi square 120 Hz untuk model jet sintetik impinging kemudian

kombinasi gelombang eksitasi sinusoidal 120 Hz dan square 80 Hz memberikan efek pendinginan yang paling optimum untuk tipe jet sintetik cross flow. Konsumsi energi yang dibutuhkan oleh jet sintetik sebanyak 1,78 joule untuk menurunkan temperatur dari 53 oC menjadi 48,2 oC sedangkan kipas menghabiskan konsumsi energi sebanyak 142,2 joule untuk dapat menurunkan temperatur dari 53 oC menjadi 48,2 oC.
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ABSTRAK
The development of the electronics industry for high performance products are characterized by the emergence of electronic devices minimalist size and low power required to use a cooling system that is reliable and efficient thus able to operate at its optimum. In this study, the technology used to cool electronic devices such components using synthetic jet which utilizes a continuous membrane movement by generating vortek ring to accelerate the process of heat transfer. Research conducted in this study aimed to explore the value of frequency, type of wave excitation, as well as the shape of the synthetic jet orifice produces good cooling performance for the model synthetic jet impinging, collision distance for influence synthetic jet impinging on the rate of convection heat transfer to the cooling process, looking for synthetic jet impinging cavity models and synthetic jet cross flow which has reliability in the process of cooling. The study is done using the method of using computational and experimental approaches. In the computational approach used CFD (computational fluid dynamics) software which defines the boundary conditions assuming a synthetic jet moving wall model with k-omega SST (Shear Stress Transport) turbulence. Then test the model using the experimental model of type impinging synthetic jet and model of synthetic jet cross flow type. The models differ in terms of synthetic jet flow direction of the media that will be cooled heatsink. Mode excitation is used to produce the synthetic jet flow using electrical signals in the form of waves sinusoidal, square dan triangular with variations in frequency of 80 hz, 120 hz and 160 hz. The electrical signals generated from the tool named sweep function generator. Results obtained from the computational and experimental information that synthetic jets can provide a cooling effect on the object to be cooled. Parameters of synthetic jet excitation frequency variation and direction of flow of synthetic jet placement varied effects in terms of cooling. From the results of the research conducted most excitation modes obtained using either 120 hz square wave excitation for the type of impinging synthetic jet models then the combination of 120 hz sinusoidal excitation wave and 80 hz square provide the most optimum cooling effect for condition type cross flow model of synthetic jet. Energy consumption required by the synthetic jet 1.78 joules to lower the temperature of 53 oC - 48.2 oC while fans spend energy consumption 142.2 joule to be able to lower the temperature of 53 oC-48.2 oC., The development of the electronics industry for high performance products are

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