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Chaotic step length artificial bee colony algorithms for protein structure prediction

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Performance evaluation of diesel–additives ternary fuel blends: An experimental investigation, numerical simulation using hybrid Entropy–TOPSIS method and economic analysis

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ABSTRACT

Research in the field of alternative, clean and renewable bio-fuels has increased dramatically in recent years for performance improvement, emission control and running cost reduction in internal combustion engines due to continuously increasing prices of conventional fuels, depletion of fossil fuels and environmental protection. In this work, a direct injection VCR diesel engine was used in experimental investigations for determining the combustion characteristics of D–NM–DEE blends at different compression ratios. By exhaust emission and performance analysis of the diesel engine at peak load and standard compression ratio (18.5), D–NM2.5–DEE7.5 (nitromethane 2.5%, diethyl ether 7.5% and diesel 90%) blend was identified as the best fuel blend among all fuel blends and pure diesel. Furthermore, all the considered fuels with different CR at peak load were ranked by the Entropy–TOPSIS method. From the analysis, D–NM2.5–DEE7.5 at CR–19.5 (ranked first with RC_i–0.922231) was found as the best fuel blend among all fuel blends and different compression ratios considered with similar experimental conditions. By the comparison of the best fuel blend (D–NM2.5–DEE7.5 at CR 19.5) with pure diesel (at standard CR 18.5), a significant improvement in engine performance, and reduction in emission and fuel cost was achieved.

1. Introduction

For many decades, continuous research is being carried out in the area of alternative clean fuels and expected to be continued due to several reasons such as increasing cost and depletion of conventional fossil fuels day by day, growing energy demand, greater air pollution and other serious environment related problems rising due to excessive burning of fossil fuels [1–3]. Fossil fuel meets about 80% of the total energy demand, out of which 50% is being used in the internal combustion (IC) engines for transportation [4,5].

Diesel is the mostly used fossil fuel, which mainly contains aliphatic hydrocarbons and its combustion in a diesel engine is responsible for various types of emissions (i.e., carbon monoxide (CO), hydrocarbon (HC), carbon dioxide (CO_2), smoke, particulate matter (PM), nitrogen oxide (NOx), etc.). In order to control these emissions, it is very important to enhance the combustion characteristic of compression ignition (CI) engine [6–8]. It can be possible by engine modification which is relatively tricky and expensive due to sophisticated design [9], or by using biodiesel which may improve the engine performance and reduce emissions, however NOx increases [10–14]. Therefore, the use of clean alternative biofuel additives with diesel has supported the substantial research in modern era to enhance engine efficiency (i.e. brake thermal efficiency (BTE) and brake specific fuel combustion (BSFC)) and reduce exhaust emissions by improving the combustion characteristics of fuel [15–17].

Very good combustion and chemical characteristics (i.e., oxygen content, cetane number (CN), low boiling point, latent heat, miscible characteristics, etc.) of nitromethane (NM) and diethyl ether (DEE) make them suitable additives for blending with diesel [18–21]. Table 1 exhibits the comparative presentation of important combustion and physico–chemical properties of diesel, nitromethane and diethyl ether. Important outcomes of research studies conducted by past researchers using nitromethane and diethyl ether with diesel are exhibited in Tables 2 and 3 respectively.

Nowadays, various multi–criteria decision–making (MCDM) techniques (i.e., Technique for order preference by similarity to ideal solution (TOPSIS), Vlse kriterijumska optimizacija kompromisno resenje (VIKOR), Elimination et choix traduisant la realite (ELECTRE), Analytic

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Resistive switching characteristics of HfO_2 based bipolar nonvolatile RRAM cell

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ABSTRACT

Non-volatile memory (NVM) will play a significant role in the progress of the next-generation of electronic products due to the physical limitations of the conventionally used flash memory. In this paper, switching properties of Cu/HfO_2/Pt/Si resistive random access memory device were successfully demonstrated. Semiconductor parameter analyzer (model no. B1500A Agilent) was used for the measurement of the resistive switching characteristics of the fabricated device. It has been observed that the device shows the bipolar mode of switching operation. The temperature dependence of electrical conductivity for low resistance state and high resistance state was also measured in the range from 300 K to 450 K. The switching behaviour of the proposed device explained on the basis of conduction filaments formed in HfO_2.

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1. Introduction

The memory which is used for storing data and program is a main component in any computer system. All recognizable computing platforms such as computer, cell phone, digital cameras, portable electronic gadget and large super-computer use storage systems for storing data, either temporarily or permanently as per their requirement [1]. Uses of nonvolatile memory (NVM) are constantly increasing, due to the huge demand of portable and consumer electronic gadgets, such as memory card, USB storage and smart phone, where NVM is used as a main component. Existing charge storage based non-volatile memory technologies like flash memories have now reached to its physical limits [2]. To overcome the limitations of traditional memories and to bring advancement in new technologies like internet of things (IOT) and big data applications, the memories should be dense, power efficient and robust. Hence nano-scale memories which do not work on charge storing magneto-resistive random access memory (MRAM) [3], ferroelectric random access memory (FeRAM) [4], resistive random access memory (RRAM) [5] and phase change random access memory (PCRAM) [6] have drawn a significant interest of researchers for future non-volatile memories. RRAM is a potential candidate for future memories due to its modest components, extraordinary compactness, low power, and exceptional scalability [7]. In recent years, the resistive switching properties in different types of metal oxides such as HfO_x [8], TiO_x [9], TaO_x [10], AlO_x [11], NiO_x [12] and ZrO_x [13] etc. have been largely observed and investigated. Among the various materials proposed for RRAM, HfO_x is potential candidate due to its superior electrical performance and exceptional compatibility with existing CMOS technology [14–15]. The HfO_2 based metal-oxide RRAM have been preferred by many researchers due to its fast operational speed, high integration, low power consumption, and high compatibility with advanced complementary metal-oxide semiconductor technologies [16–17].

Basic resistive switching memory cell as shown in Fig. 1, consists of an insulating/resistive material layer sandwiched between two conductive electrodes. Depending on the polarity of voltage the resistive switching behaviour of RRAM is divided as unipolar switching or bipolar switching. In unipolar switching, resistive switching is induced by a voltage of same polarity but a different magnitude (as shown in Fig. 2). On the other hand, in bipolar switching resistive switching is induced by a voltage of opposite

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Use of 2–methoxyethyl ether and nitromethane as oxygenated additives for performance improvement and emission reduction of CI engine: experimental investigation and numerical simulation

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Contributions

Chandan Kumar and Kunj Bihari Rana: conceptualization, analysis, writing, reviewing, and editing; Priyanka Verma and Meghna Mahar: experimentation and writing; Shyam Sundar Sharma: supervision.

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