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IMMC2026 PROGRAMME
IMMC2026 PROGRAMI

HALL-3 **10.00 - 11.00** **Opening Ceremony /** Açılış Töreni

	FUAYE RED HALL KIRMIZI SALON		HALL-6 BLUE HALL MAVİ SALON		HALL-5 PURPLE HALL MOR SALON
13.00 - 14.10 Session **1** Oturum	**CRMS** **Critical Raw Materials and Rare Earth Elements Symposium** Kritik Hammaddeler ve Nadir Toprak Elementleri Sempozyumu	**13.30 - 14.00**	**NMS** **Nanomaterials Symposium** Nanomalzemeler Sempozyumu	**13.00 - 14.20**	**NFMS** **Non-Ferrous Metals Symposium** Demir Dışı Metaller Sempozyumu
Coffee Break / Kahve Molası					
14.30 - 15.50 Session **2** Oturum	**CRMS** **Critical Raw Materials and Rare Earth Elements Symposium** Kritik Hammaddeler ve Nadir Toprak Elementleri Sempozyumu	**14.20 - 15.40**	**NMS** **Nanomaterials Symposium** Nanomalzemeler Sempozyumu	**14.40- 16.00**	**NFMS** **Non-Ferrous Metals Symposium** Demir Dışı Metaller Sempozyumu
Coffee Break / Kahve Molası					
16.10 - 17.10 Session **3** Oturum	**AIMLS** **Artificial Intelligence and Machine Learning Symposium** Yapay Zekâ ve Makine Öğrenmesi Sempozyumu	**16.00 - 17.20**	**BMS** **Biomaterials Symposium** Biyomalzemeler Sempozyumu	**16.20 - 17.40**	**NFMS** **Non-Ferrous Metals Symposium** Demir Dışı Metaller Sempozyumu

23 OCTOBER 2026 FRIDAY
23 EKİM CUMA

	FUAYE RED HALL KIRMIZI SALON		HALL-6 BLUE HALL MAVİ SALON		HALL-5 PURPLE HALL MOR SALON
10.00 - 11.20 Session 1 Oturum	**URS** **Undergraduate Research Symposium** Lisans Öğrencileri Araştırma Sempozyumu	10.00 - 11.20	**STS** **Steel Symposium** Çelik Sempozyumu	10.00 - 11.00	**AMTS** **Additive Manufacturing Technologies Symposium** Eklemeli İmalat Teknolojileri Sempozyumu
Coffee Break / Kahve Molası					
11.40 - 12.50 Session 2 Oturum	**RSS** **Recycling and Sustainability Symposium** Geri Dönüşüm ve Sürdürülebilirlik Sempozyumu	11.40 - 12.40	**STS** **Steel Symposium** Çelik Sempozyumu	11.20 - 12.20	**AMTS** **Additive Manufacturing Technologies Symposium** Eklemeli İmalat Teknolojileri Sempozyumu
Lunch / Öğle Yemeği					
13.30 - 14.50 Session 3 Oturum	**RSS** **Recycling and Sustainability Symposium** Geri Dönüşüm ve Sürdürülebilirlik Sempozyumu	13.30 - 14.50	**STS PANEL** **Sustainability in Iron and Steel** Demir Çelikte Sürdürülebilirlik	13.30 - 15.20	**EMS** **Energy Materials Symposium** Enerji Malzemeleri Sempozyumu
Coffee Break / Kahve Molası					
15.10 - 16.30 Session 4 Oturum	**RSS** **Recycling and Sustainability Symposium** Geri Dönüşüm ve Sürdürülebilirlik Sempozyumu	15.10 - 16.30	**STS** **Steel Symposium** Çelik Sempozyumu	15.40 - 16.40	**CPMS** **Composite and Polymer Materials Symposium** Kompozit ve Polimer Malzemeler Sempozyumu
Coffee Break / Kahve Molası					
		16.50 - 17.50 Session 5 Oturum	**OHSS** **Occupational Health and Safety Symposium** İş Sağlığı ve Güvenliği Sempozyumu	17.00 - 18.00	**CPMS** **Composite and Polymer Materials Symposium** Kompozit ve Polimer Malzemeler Sempozyumu

24 OCTOBER 2026 SATURDAY
24 EKİM CUMARTESİ

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10.00 - 11.20 Session 1 Oturum	**STCS** **Surface Treatment and Coating Symposium** Yüzey İşlemler ve Kaplama Sempozyumu	10.00 - 11.00	**CGRS** **Ceramics, Glass, Refractory Materials Symposium** Seramik, Cam, Refrakter Malzemeler Sempozyumu	10.00 - 10.40	**WNTS** **Welding and Non-Destructive Testing Symposium** Kaynak ve Tahribatsız Muayene Sempozyumu
Coffee Break / Kahve Molası					
11.40 - 12.50 Session 2 Oturum	**STCS** **Surface Treatment and Coating Symposium** Yüzey İşlemler ve Kaplama Sempozyumu	11.20 - 12.40	**CGRS** **Ceramics, Glass, Refractory Materials Symposium** Seramik, Cam, Refrakter Malzemeler Sempozyumu	11.20 - 12.40	**FAHTS** **Failure Analysis and Heat Treatment Symposium** Hasar Analizi ve Isıl İşlem Sempozyumu
Lunch / Öğle Yemeği					
14.00 - 15.00 Session 3 Oturum	**CWS** **Corrosion and Wear Symposium** Korozyon ve Aşınma Sempozyumu	14.00 - 14.40	**CGRS** **Ceramics, Glass, Refractory Materials Symposium** Seramik, Cam, Refrakter Malzemeler Sempozyumu		

Undergraduate Research
Lisans Öğrencileri Araştırma

URS-1
The Influence of Porosity on Laser Cutting of Cu-Ni-Mo Based Steel Foams

Mustafa Ali KAÇAN, Esra ÜNAL, Pelin KAYA, Gizem KARABULUT ŞEVK, Nuray BEKÖZ ÜLLEN

İstanbul University-Cerrahpaşa
Türkiye

URS-2
Copper-Based Porous Metals: An Overview of Manufacturing and Applications

Azra ASLAN, Sıla KUZU, Çisem CERAN, Gizem KARABULUT ŞEVK, Nuray BEKÖZ ÜLLEN

İstanbul University-Cerrahpaşa
Türkiye

URS-3
Microstructure Properties of Ni-Mn-O Based Spinel Oxide Ceramics

Hasan Kutay VERİM[1], Gökhan HARDAL[2], Caner İLDEŞ[3], Berat Yüksel PRICE[1]

[1]İstanbul University-Cerrahpasa, [2]İstanbul University, [3]Yozgat Bozok University
Türkiye

URS-4
Effect of Electrolyte Composition on the Properties of PEO Coatings Synthesized on Al-9Cu Alloy

Talha ÖZASLAN, MuhammeT Taha DALGIC, Harun BİRİNCİ, Kral Ali COŞAN, Mehmet TARAKCI, Yücel GENCER

Gebze Technical University
Türkiye

URS-5
Role of Mg and Ti Additions in Controlling the Microstructure and Mechanical Properties of Compacted Graphite Iron

Ahmet Buğra KEYVANKLI[1], Ahmet ÖZEL[2], Süleyman Can KURNAZ[2], Tan EMİR[1]

[1]Ferro Döküm, [2]Sakarya University
Türkiye

URS-6
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The Influence of Porosity on Laser Cutting of Cu-Ni-Mo Based Steel Foams

Mustafa Ali KAÇAN, Esra ÜNAL, Pelin KAYA, Gizem KARABULUT ŞEVK, Nuray BEKÖZ ÜLLEN
İstanbul University-Cerrahpaşa
Türkiye

Keywords: Metal foam, machinability, laser cutting

Abstract
Steel foams are a new class of engineering materials with exceptional structure and properties. Many metal-based foam materials produced by powder metallurgy generally have a near-net shape; however, sometimes secondary machining operations may be required. The presence of porosity in the steel foam structure significantly changes the cutting process and causes poor machinability. The effect of porous structure on cutting was not declared, and so it is an interesting research topic. This study deals with the evaluation of the machinability of Cu-Ni-Mo-based steel foams with approximately 50%, 60%, 70% and 80% porosity produced by powder metallurgy. Steel foams with both open and closed-pore structures are cut using argon laser cutting technology. During the cutting of all steel foams having different porosities, the laser cutting parameters were kept constant: cutting speed 10 m/min, cutting power 3000 W, cutting pressure 15 bar, nozzle diameter 0.8 mm, and part-nozzle distance 5 mm. Morphological changes in the cutting area were examined by SEM, and hardness tests were also performed. The results indicated that the increase in porosity negatively affected the cut surface quality of steel foams. The thin cell walls resulted in faster cooling and hardness changes at high porosity.

1. Introduction

Metallic foams, which have gained prominence in recent years as a new-generation engineering material, have found their place in applications for lightweight materials due to their low density. As a result of the unique properties such as high strength, excellent energy, sound, and vibration damping, high thermal absorption, high fire resistance, structural stability at high temperatures, the absence of toxic byproducts during combustion, and chemical filtration capabilities, they are used in the automotive, aerospace, and defense industries, as well as in rail and maritime transportation, and in lightweight construction within the construction sector [1-6]. Because of their wide range of applications, metal foams are the subject of research for many researchers in both scientific and industrial fields [2-11]. The structural and functional applications of metallic foams are primarily governed by their cell morphology, categorized as either open- or closed-cell structures. Numerous studies indicate that closed-pore structures exhibit high stiffness, strength, and impact resistance, whereas open-pore structures, despite their lower stiffness, offer superior heat transfer and sound absorption properties [1,12]. Conducted studies have shown that, in order for metallic foams to be utilized in a versatile manner in current engineering applications, machining methods, known as secondary processes, must also be investigated. However, there is a limited number of studies related to this subject in the literature [13-18].

Although porous metal structures produced via powder metallurgy generally exhibit near-net-shaped geometries, additional secondary processing is frequently required. Extracting dense, porous components with complex geometries directly from the mold is a challenging and cost-prohibitive process. Therefore, machining methods are essential to impart the final shape to porous metal parts. Machining offers significant advantages, such as eliminating the need for complex molds, thereby enabling the cost-effective production of intricate structures. Operations such as cutting, drilling, and joining via bolting or welding can be performed using conventional turning and milling, as well as advanced machining techniques including laser cutting, wire electrical discharge machining (EDM), and plasma cutting [13,19-21]. The poor machinability of porous metals stems from their highly heterogeneous structure, which contains macro- and micro-pores. It is quite difficult to evaluate the effect of pore structure on the machinability of porous metals independently from all other factors and to determine its effect on the machining process [21-22]. In recent years, the laser cutting process has come to the fore for efficiently and directly cutting regular shapes in the structure without damaging the pore structure of the metallic foam. In recent years, fiber lasers, which have developed in parallel with communication technology, have begun to be used in enterprises due to their high efficiency, although their cost is relatively high. Materials such as steel, nickel alloys, titanium, chromium, stainless steel, aluminum, and its alloys can be cut by laser. The advantages of laser cutting are: no cutting mold and apparatus are required, high cutting speed, smooth cutting surface, and low cost. A high-density laser beam is formed in the shape of a small spot, and the heat-affected zone is minimal due to rapid cooling [16,17,21]. Raza et al. [23] investigated metal foam production via laser deposition techniques and analyzed the laser cutting processing of porous aluminum and titanium alloys. Liu et al. [24] used the laser cutting process for the efficient and direct cutting of metal foams with three different types and two different pore densities into regular shapes. The results indicate that metal foam with good surface quality can be obtained without damaging the pore structure.

There are limited studies, technical, and scientific deficiencies regarding the presence of macro and micro pores that complicate the cutting process in porous metals. The existence of these pores, which cause the low machinability of metallic foams, should be scientifically investigated. Especially, the effect of macro pores on machinability is much greater. The widespread use of these materials has made it mandatory to consider machining processes in detail to ensure easier and more economical production stages, produce complex-shaped parts, and achieve better surface quality. In this study, the machinability of Cu-Ni-Mo-based steel foams with 50%, 60%, 70%, and 80% porosity produced by powder metallurgy was addressed using laser cutting technology.

2. Experimental Procedure

In this study, low-alloy steel foams with different

porosities, produced with a diameter of 12 mm and a height of approximately 18 mm using the space holder technique, were selected as the workpiece material. The production processes of the porous metal parts have been described in previous articles [3-4]. The visual representation of Cu-Ni-Mo-based steel foams with approximately 50%, 60%, 70%, and 80% porosity produced from pre-alloyed Distaloy AB steel powders containing 1.5% Cu, 1.75% Ni, 0.5% Mo, and the balance Fe is given in Figure 1.



Figure 1. Cu-Ni-Mo based steel foams containing different ratios of porosity

The laser cutting process was performed at HARYO Machinery Industry Inc. using an RGWEL brand, RG W2000P model machine. Both open and closed-pore steel foams, photographed in Figure 1, were cut using argon laser cutting technology. Nitrogen gas was preferred in material cuttings due to the difficulty in controlling the oxygen reaction and for cutting quality. During the cutting of all steel foams with different porosities, the laser cutting parameters were kept constant: cutting speed 10 m/min, cutting power 3000 W, cutting pressure 15 bar, nozzle diameter 0.8 mm, and part-nozzle distance 5 mm. The laser cutting of porous metal parts is shown in Figure 2. Morphological changes on the cross-sectional surface were examined by SEM (Jeol JSM–5600), and micro-Vickers hardness tests (HMV-G21S; Shimadzu) were also performed. To evaluate changes in surface hardness, hardness measurements were carried out under a 1N load for duration of 10 seconds.



Figure 2. Laser cutting of porous metal parts

3.Results and Discussion

The laser cutting process of porous metals consists of three stages. In the initial stage of the cutting process, when the laser begins to emit radiation onto the surface of the metal foam, a large portion of the laser energy is absorbed by the foam-like structure. Subsequently, the surface temperature of the metallic foam rises rapidly, but the walls do not melt or gasify. As time passes, the temperature reaches the melting point of the metal foam, and the pore walls begin to melt. A molten pool is formed in the area where the laser radiates. When the laser irradiation time is further increased, the surfaces of the metal foam gasify, and a plasma with higher ionization is formed, thereby cutting the surface of the metal foam [14,15,25].

Many advantages can be mentioned in the laser cutting of metallic materials containing high rates of porosity. Burr-free, parallel-edged, and narrow cuts, which are difficult to achieve in mechanical cutting, can be obtained in laser cutting. The mechanical cutting process causes a significant amount of deformation and collapse in the cut area of the porous structure, which may lead to changes in effective properties. This situation can be prevented by laser cutting. Especially for the precise contour cutting of small and medium-scaled works, the laser is relatively more economical due to its flexibility. Compared to band saw cutting, laser cutting exhibits much higher precision, and compared to wire EDM, it is much faster and more economical. The foamy structure is brittle; therefore, the laser beam can be preferred since it does not require mechanical contact [25,26]. Simancik et al., [27], reported that, unlike the cutting of aluminum foam sandwiches with mechanical force, laser cutting does not cause deformation at the edges. The surface integrity of foamy metal structures depends on the surface quality obtained after machining. The presence of pores in the structure is also highly influential on surface quality. In Figure 3, SEM images of the cutting surfaces of Cu-Ni-Mo based steel foams containing different ratios of porosity after laser cutting are given.

The greatest advantage of the laser cutting process is that high cutting speeds (10 m/min in this study) can be achieved. The disadvantages, on the other hand, are the poor surface quality in the cut regions at the outer boundaries, especially in parts with 80% porosity, the adhesion of the molten metal to the pore walls, and the degradation of the structure with an increasing porosity ratio. Due to the slow progression of heat density in the cutting zones at high porosity ratios, the molten metal could not be removed from the environment, fill the macro-pore cavities, and significantly deteriorate the surface quality. As seen in Figure 3 (d), the melting metal adhered to the cutting surfaces, and because it could not be removed from the environment, it cooled and solidified, significantly degrading the quality of the surface. High porosity and low thermal conductivity reinforce the cutting surface by preventing cooling, leading to the melting and bending of pore walls, and the bent pore walls flow toward other pores, increasing the density there [28]. Yilbas et al. [17] reported that due to the presence of oxygen in the pores, oxide compounds were formed during the laser cutting of aluminum foam, and the increased viscosity of the formed aluminum oxides caused burrs that resisted metal flow.

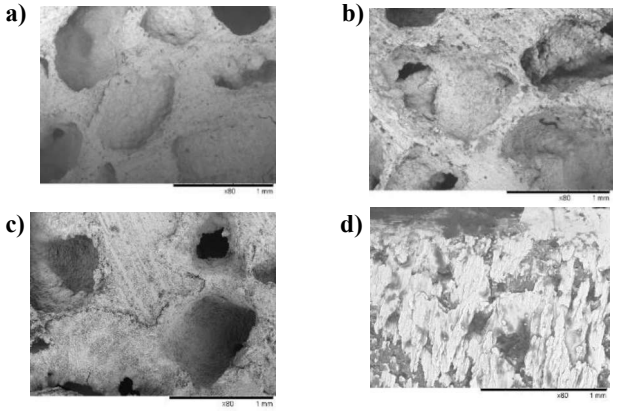

Figure 3. SEM images of the cutting surface image after laser cutting: parts containing a) %50, b) %60, c) %70 and d) %80 porosity

Although cutting at low porosity ratios involves some burrs, it allows the part to be used after a secondary operation, such as grinding/sanding, on free surfaces and non-functional areas in applications where cutting is not precise. In the laser cutting process, the melt resulting from the heat adheres to the pore walls and deforms the pore structure. Some studies indicate that this situation can be eliminated by optimizing the parameters [14-15,25,27,28]. Liu et al. [16], reported in their study that even after parameter adjustments were made, the laser beam altered the pore characteristics while passing through the air gaps between the foam metal until it reached the other cell wall, resulting in a non-homogeneous cut between layers. Raza et al. [23], stated that there was a small amount of residual stress in the laser cutting of aluminum foam plates, and there was almost no change in the material composition at the cutting area. Kathura [29], cut aluminum foam with a laser and stated that the pore walls were deformed under the effect of high temperature. De Jaeger P. [30], reported in his study that the laser cutting process could lead to very different contact areas in highly porous structures, and this condition could cause intense deformation. Microstructural analysis allows for a partial description of the effect of the drilling process on porosity. However, the machining characteristics of the material must be described by accurately correlating them with the microhardness of the microstructural components. Figure 4 shows the microhardness values of steel foams containing different ratios of porosity before and after laser cutting.

Microhardness changes after laser cutting are observed more prominently with the increasing porosity ratio. In microhardness, an increase of approximately 8%, 13%, 15%, and 20% occurred in samples containing 50%, 60%, 70%, and 80% porosity, respectively. This situation stems from the new microstructure formed during cutting and plastic deformation [13,20,22,31]. Robert-Perron et al. [32], reported that the increase in porosity reduces the thermal conductivity of the powder material and eliminates its ability to reduce the heat generated in the cutting zone. This causes work hardening at locally generated high temperatures in the cutting tool and workpiece contact zones. In another study, it was explained that the high hardness produced is mainly due to plastic deformation and friction between the tool and the machined surface [33].

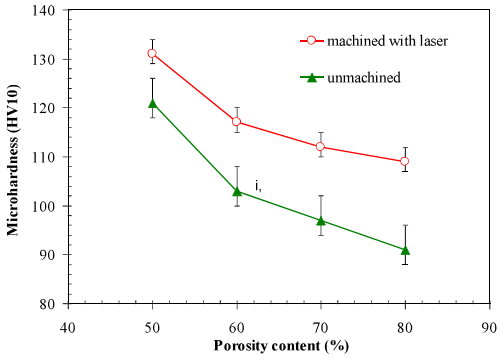

Figure 4. Microhardness changes on the machined surface with different porosities.

4. Conclusion

Metallic porous structures are among the new-generation materials that possess unique properties compared to conventional materials and are striving to find their place in the industry. For these materials to become widespread, it is primarily important to investigate their machinability. In this study, steel foam structures containing different ratios of porosity were cut with a laser, and the cut surfaces were evaluated in terms of microstructure and microhardness properties.

In steel foams containing a low ratio of porosity, no crushing or bending is observed in the pore walls after laser cutting. The pore walls expanded and solidified during cutting, maintaining the structure they formed after the process as well. In the highly porous structure, the molten metal in the laser-cut regions adhered to the pore walls, deteriorating the surface quality. An increase in microhardness values was observed in all steel foams after laser cutting. The microhardness value increased with the increasing porosity ratio. Consequently, the quality of the cut surfaces after laser cutting varied according to the porosity ratio. Especially with the increasing porosity ratio, the surface quality deteriorated significantly. In order to prevent the surface degradation experienced in parts containing high ratios of porosity, laser cutting parameters (cutting speed, cutting power, cutting pressure, nozzle diameter, focal distance, gas type, nozzle-sheet distance) must be optimized.

Acknowledgment

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