Weber, M. J. “Commercial Lasers”
Handbook of Laser Wavelengths.
Ed. Marvin J. Weber
Boca Raton: CRC Press LLC, 1999

Section 6: Commercial Lasers

Section 6

COMMERCIAL LASERS

Introduction to the Table

Commercial lasers are arranged in order of increasing wavelength in Table 6.1. The medium (gas, liquid, or solid), laser type, and mode of operation (pulsed or cw) are given. The data were compiled from recent (1995–1997) laser buyers' guides and manufacturer's literature may not be the only lasers available commercially nor may the lasers still be manufactured. Representative output power or energies of solid state (crystalline, glass, and polymer), semiconductor, liquid organic dye, and gas lasers are given in Tables 6.1.1, 6.2.1, 6.3.1, and 6.4.1, respectively. These latter data are also taken from recent (1995–1997) laser buyers' guides and can be expected to change due to advances in technology.

Tunable lasers are listed by their reported shortest and longest wavelengths for the pumping conditions used. Wavelengths enclosed in brackets denote the extremes of a group of discrete laser lines or chemical compositions.

Abbreviations: SH - second harmonic, TH - third harmonic, FH - fourth harmonic, FFH - fifth harmonic, R - Raman shifted, OPO - optical parametric oscillator. Acronyms and abbreviations for laser types are defined in Appendix 2.

Further Reading

Hecht, J., *The Laser Guidebook* (second edition), McGraw-Hill, New York (1992).

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Technology and Industry Reference, Lasers and Optronics, Morris Plains, NJ.

Optical Industry and Systems Purchasing Directory, Optical Publishing, Pittsfield, MA.

Table 6.1
Commercial Lasers Arranged in Order of Increasing Wavelength

Wavelength (μm)	Medium	Laser Type	Operation
0.157	gas	F_2 excimer	pulsed
0.193	gas	ArF excimer	pulsed
0.2–0.4	liquid	organic dyes (SH)	pulsed
0.209	solid	Nd:YLF (FFH)	pulsed
0.213	solid	Nd:YAG (FFH)	pulsed
0.22–0.39	liquid	organic dyes (SH)	cw
0.222	gas	KrCl excimer	pulsed
0.2243	gas	He-Ag^+	pulsed, cw
0.248	gas	KrF excimer	pulsed
[0.248–0.270]	gas	Ne-Cu^+	pulsed, cw
0.25–0.30	solid	Ti:sapphire (TH)	pulsed
0.263	solid	Nd:YLF (FH)	pulsed
0.266	solid	Nd:YAG (FH)	pulsed, cw
[0.282–0.292]	gas	He-Au^+	pulsed, cw
0.308	gas	XeCl excimer	pulsed
0.325	gas	He-Cd	cw
0.3324	gas	Ne ion	cw
0.3371	gas	nitrogen (N_2)	pulsed
0.347	solid	ruby (SH)	pulsed
0.351	gas	Ar ion	cw
0.351	gas	XeF excimer	pulsed
0.351	solid	Nd:YLF (TH)	pulsed
0.355	solid	Nd:glass (TH)	pulsed
0.355	solid	Nd:YAG (TH)	pulsed, cw
0.36–0.40	solid	alexandrite (SH)	pulsed
0.36–0.46	solid	Ti:sapphire (SH)	pulsed, cw
0.3713	gas	Ne	cw
0.373	gas	Ne	cw
0.38–1.0	liquid	organic dyes	pulsed, cw
0.415	solid	GaN	pulsed
0.42–0.43	solid	GaAlAs (SH)	cw
0.430	solid	Ce:$LiSrAlF_6$	cw
0.4416	gas	He-Cd	cw
0.4545	gas	Ar ion	cw
0.4579	gas	Ar ion	cw

Table 6.1—*continued*
Commercial Lasers Arranged in Order of Increasing Wavelength

Wavelength (μm)	Medium	Laser Type	Operation
[0.458–0.676]	gas	Ar–Kr ion	cw
0.473	solid	Nd:YVO_4 (SH)	cw
0.4762	gas	Kr ion	pulsed, cw
0.4765	gas	Ar ion	pulsed, cw
[0.48–0.54]	gas	Xe ion	pulsed
0.4880	gas	Ar ion	pulsed, cw
0.4965	gas	Ar ion	cw
0.5017	gas	Ar ion	pulsed, cw
0.5105	gas	Cu vapor	pulsed
0.5145	gas	Ar ion	pulsed, cw
0.5208	gas	Kr ion	pulsed, cw
0.523	solid	Nd:YLF (SH)	pulsed, cw
0.527	solid	Nd:YLF (SH)	pulsed, cw
0.527	solid	Nd:glass (SH)	pulsed
0.5287	gas	Ar ion	pulsed, cw
0.531	solid	Nd:YAB (SH)	pulsed, cw
0.5319	gas	Kr ion	pulsed, cw
0.532	solid	Nd:YAG (SH)	pulsed, cw
0.532	solid	Nd:YVO_4 (SH)	cw
0.5395	gas	Xe ion	pulsed
[0.543–3.39]	gas	He-Ne	cw
0.5435	gas	He-Ne	cw
[0.55–0.70]	solid	organic dye	pulsed
0.5782	gas	Cu vapor	pulsed
0.58–0.66	solid	Cr:Mg_2SiO_4 (SH)	pulsed
0.5941	gas	He-Ne	cw
0.6119	gas	He-Ne	cw
0.628	gas	Au vapor	pulsed, cw
[0.63–0.68]	solid	InGaAlP	cw
0.6328	gas	He-Ne	cw
0.6471	gas	Kr ion	pulsed, cw
0.67	solid	GaAsP	pulsed, cw
0.67–1.13	solid	Ti:sapphire	cw
0.6764	gas	Kr ion	pulsed, cw
0.68	solid	InGaAlP	pulsed

Table 6.1—*continued*
Commercial Lasers Arranged in Order of Increasing Wavelength

Wavelength (μm)	Medium	Laser Type	Operation
0.6943	solid	ruby	pulsed, cw
0.7–0.8	solid	alexandrite	cw
0.7–1.1	solid	Ti:sapphire	pulsed
0.72–0.82	solid	alexandrite	pulsed
0.74–0.84	solid	Cr:GSGG	pulsed
[0.75–0.85]	solid	GaAlAs	pulsed, cw
0.7525	gas	Kr ion	pulsed, cw
0.78–0.85	solid	$Cr:KZnF_3$	pulsed
[0.78–0.91]	solid	GaAlAs	pulsed
0.78–1.01	solid	Cr:LiSAF	pulsed
0.7993	gas	Kr ion	pulsed, cw
0.85	solid	Er:YLF	pulsed
0.9–4.5	liquid	organic dyes (R)	pulsed
0.904	solid	GaAs	pulsed
0.91–0.98	solid	InGaAs	pulsed, cw
0.946	solid	Nd:YAG	pulsed
1.04–1.2	solid	alexandrite (R)	pulsed
1.047	solid	Nd:YLF	pulsed, cw
1.053	solid	Nd:YLF	pulsed, cw
1.053	solid	Nd:phosphate glass	pulsed
1.053	solid	Nd:YAP (YALO)	pulsed
1.06	solid	Nd:YAB	pulsed, cw
1.061	solid	Nd: silicate glass	pulsed
1.061	solid	Nd:GSGG	pulsed
1.062	solid	Nd:GGG	pulsed
1.064	solid	Nd:YAG	pulsed, cw
1.079	solid	Nd:YAP (YAlO)	pulsed
1.09–1.27	solid	LiF (F_2^-)	pulsed
[1.1–1.55]	solid	InGaAsP	pulsed, cw
1.13–1.36	solid	$Cr:Mg_2SiO_4$	pulsed
1.152	gas	He-Ne	cw
1.313	solid	Nd:YLF	pulsed, cw
1.315	gas	iodine	pulsed
1.319	solid	Nd:YAG	pulsed, cw
1.321	solid	Nd: YLF	cw

Table 6.1—*continued*
Commercial Lasers Arranged in Order of Increasing Wavelength

Wavelength (μm)	Medium	Laser Type	Operation
1.335	solid	Nd: YAG	pulsed, cw
1.39	solid	Nd:YAG (R)	pulsed
1.45–1.85	solid	NaCl:OH (F_2^+)	cw
1.48–1.72	solid	NaCl:OH (F_2^+)	pulsed
1.52–1.57	solid	Er:glass	pulsed, cw
1.523	gas	He-Ne	cw
1.54	solid	Er:silica	pulsed
1.54	solid	Nd:YAG (R)	pulsed
1.75–2.50	solid	Co:MgF_2	pulsed, cw
1.85–2.16	solid	Co:MgF_2	pulsed
1.91	solid	Nd:YAG (R)	pulsed
[2–4]	gas	Xe-He	pulsed, cw
[2.006–2.025]	solid	Tm:YAG	pulsed, cw
2.019, 2.033	solid	Tm:LuAG	pulsed, cw
[2.048–2.069]	solid	Ho: YLF	pulsed
2.088	solid	Ho: YSGG	pulsed
2.09	solid	Ho,Tm,Cr:YAG	pulsed, cw
[2.088–2.091]	solid	Ho:YAG	pulsed, cw
2.127	solid	Ho:YAG	cw
2.30–2.50	solid	KCl:Na (F_B)	cw
2.45–2.80	solid	KCl:Li (F_A)	cw
2.52–2.90	solid	KCl:Li (F_A)	pulsed
[2.6–3.0]	gas	HF (chemical)	pulsed, cw
2.70–3.30	solid	RbCl:Li (F_A)	cw
2.73–3.18	solid	RbCl:Li (F_A)	pulsed
2.796	solid	Er,Cr:YSGG	pulsed
2.9–3.6	solid	Pb salts (77 K)	cw
2.90	solid	Er:YAG	pulsed, cw
2.94	solid	Er:YAG	pulsed, cw
3.3–27	solid	Pb salts	pulsed, cw
3.391	gas	He-Ne	cw
[3.6–4.0]	gas	DF (chemical)	pulsed, cw
[5–7]	gas	CO	cw
[9.2–11.4]	gas	CO_2	pulsed, cw

Table 6.1—*continued*
Commercial Lasers Arranged in Order of Increasing Wavelength

Wavelength (μm)	Medium	Laser Type	Operation
10.6	gas	CO_2	pulsed, cw
10.65	gas	N_2O	pulsed, cw
[10.3–11.1]	gas	N_2O	cw
[37–1224]	gas	methanol (CH_3OH)	pulsed, cw
[40–1200]	gas	various molecules[(a)]	pulsed, cw
[496,1222]	gas	methyl fluoride (CH_3F)	pulsed, cw

(a) See footnote to Table 6.4.1 for examples of specific molecules.

Section 6.1

SOLID STATE LASERS

Introduction to the Table

Commercial solid state lasers, mode of operation (cw or pulsed), principal wavelengths, and representative outputs are given in Table 6.1.1.

Abbreviations: SH - second harmonic, TH - third harmonic, FH - fourth harmonic, FFH - fifth harmonic, R - Raman shifted, SD - self doubled, DP – diode pumped.

Table 6.1.1
Commercial Solid State Lasers

Laser Type	Operation	Principal wavelengths (μm)	Output
Lanthanide Lasers:			
Nd: YAB [$YAl_3(BO_3)_4$]	cw	0.53 (SH)	10 mW
	cw	1.06	10–200 W
	cw (DP)	1.06	0.1–1 W
Nd:YAG ($Y_3Al_5O_{12}$)	pulsed	0.213 (FFH)	4–15 mJ
	cw	0.266 (FH)	0.02–0.6 W
	pulsed	0.266 (FH)	1–300 mJ
	cw	0.355 (TH)	0.01–1.5 W
	pulsed	0.355 (TH)	1–800 mJ
	cw	0.532 (SH)	0.1–60 W
	cw (DP)	0.532 (SH)	0.1–0.5 W
	pulsed	0.532 (SH)	0.1–100 J
	pulsed (DP)	0.532 (SH)	0.001–0.1 J
	cw	0.946	10 mW
	cw (multimode)	1.064	1–3000 W
	cw (TEM_{00})	1.064	0.1–60 W
	cw (DP)	1.064	1 mW–20 W
	pulsed (multi.)	1.064	0.1–2000 J
	pulsed (TEM_{00})	1.064	1–2.5 J
	pulsed (DP)	1.064	0.1–250 mJ
	cw	1.319	0.2–100 W
	cw (DP)	1.319	0.2–2 W
	pulsed	1.319	1–5 J

Table 6.1.1—*continued*
Commercial Solid State Lasers

Laser Type	Operation	Principal wavelengths (μm)	Output
Nd:YLF ($LiYF_4$)	pulsed	0.209 (FFH)	0.2 mJ
	pulsed	0.263 (FH)	0.2–2 mJ
	pulsed	0.351 (TH)	0.3–2 mJ
	pulsed	0.523 (SH)	0.02–15 mJ
	pulsed	0.527 (SH)	1–15 mJ
	cw	1.047	0.5–6 W
	cw (DP)	1.047	0.5–2 W
	pulsed	1.047	0.5 J
	pulsed (DP)	1.047	0.01–0.15 J
	cw	1.053	2–45 W
	cw (DP)	1.053	0.5–5 W
	pulsed	1.053	0.1–10 J
	pulsed (DP)	1.053	≤ 1 mJ
	cw	1.313	1.5–3 W
	cw (DP)	1.313	0.04–0.8 W
	pulsed (DP)	1.313	$\leq 10^{-5}$ J
	cw	1.321	40-200 mW
Nd:YVO_4	pulsed (DP)	0.355 (TH)	30 mW
	cw	0.473 (SH)	1–100 mW
	cw (DP)	0.473 (SH)	20 mW
	cw	0.532 (SH)	0.01–5 W
	cw (DP)	0.532 (SH)	10–50 mW
	pulsed	1.064	≤ 150 mJ
	cw	1.064	2.5–10 W
Nd:GGG ($Gd_3Ga_5O_{12}$)	pulsed	1.062	14 J
Nd:YAP or YALO ($YAlO_3$)	cw, pulsed	1.079	≤ 60 W
Nd,Cr:GSGG ($Gd_3Sc_2Ga_3O_{12}$)	pulsed	1.061	0.5–40 J
Nd:glass (phosphate)	pulsed	0.263 (FH)	0.04–4 J
	pulsed	0.351 (TH)	0.1–8 J
	pulsed	0.527 (SH)	0.2–22 J
	pulsed	1.054	1.0–80 J
Nd:glass (silicate)	pulsed	0.26 (FH)	0.1–0.8 J
	pulsed	0.35 (TH)	0.3–2 J
	pulsed	0.53 (SH)	0.1–5 J
	pulsed	1.06	0.2–20 J

Table 6.1.1—*continued*
Commercial Solid State Lasers

Laser Type	Operation	Principal wavelengths (μm)	Output
Ho:YLF	cw	2.048–2.069	0.05–1 W
Ho:YAG ($Y_3Al_5O_{12}$)	cw	2.088–2.091	0.05–1 W
	pulsed	2.1	1–5 J
Ho:YSGG ($Y_3Sc_2Ga_3O_{12}$)	pulsed	2.088	3 J
Ho,Tm,Cr:YAG ($Y_3Al_5O_{12}$)	cw	2.09	0.05–1 W
	pulsed	2.09	0.5–2 J
Er:glass	pulsed (DP)	1.54	1.2 J
Er:glass (fiber)	cw	1.52–1.57	30 mW
	cw (DP)	1.54	50 mW
	pulsed	1.54	0.5–10 mJ
Er:YAG ($Y_3Al_5O_{12}$)	cw	2.90, 2.94	2–10 W
	pulsed	2.90, 2.94	1–4 J
Er:YSGG ($Y_3Sc_2Ga_3O_{12}$)	pulsed	2.79	2 J
Tm:LuAG ($Lu_3Al_5O_{12}$)	pulsed (DP)	2.019, 2.033	0.01 J
	cw	2.019, 2.033	0.05–1 W
Tm:YAG ($Y_3Al_5O_{12}$)	pulsed	2.01	2 J
	cw	2.006–2.025	0.05–1 W
Transition Metal Lasers:			
Ruby (Cr:Al_2O_3)	pulsed (SH)	0.347	0.1–0.3 J
	cw	0.6943	7 W
	pulsed	0.6943	0.3–100 J
Alexandrite (Cr:$BeAl_2O_4$)	pulsed	0.36–0.4 (SH)	10–500 mJ
	cw	0.7–0.8	0.1–2 W
	pulsed	0.72–0.82	10 mJ–3 J

Table 6.1.1—*continued*
Commercial Solid State Lasers

Laser Type	Operation	Principal wavelengths (μm)	Output
Ti: sapphire ($Ti:Al_2O_3$)	pulsed	0.25–0.30 (TH)	50 μJ–1 mJ
	cw	0.36–0.46 (SH)	0.01-0.2 mW
	pulsed	0.36–0.45 (SH)	0.3–25 mJ
	cw	0.67–1.13	0.25–5 W
	pulsed	0.7–1.1	10 mJ–3J
Cobalt perovskite ($Co:MgF_2$)	pulsed	1.75–2.5	20–25 mJ
Chromium:LiSAF ($Cr:LiSrAlF_6$)	pulsed	0.78–1.01	2 mJ
Chromium fluoride ($Cr:KZnF_3$)	cw	0.78–0.85	1 W
	pulsed	0.78–0.85	10 mJ
Forsterite ($Cr:Mg_2SiO_4$)	pulsed	0.58–0.66 (SH)	2 mJ
	pulsed	1.13–1.36	0.1–20 J
Color Center Lasers:			
LiF (F_2^+)	pulsed	1.09–1.27	≤ 50 mJ
NaCl:OH (F_2^-)	cw	1.45–1.85	0.35 W
	pulsed	1.48–1.72	0.1 J
KCl:Na (F_B)	cw	2.30–2.55	1–100 mW
KCl:Li (F_A)	cw	2.45–2.80	100 mW
	pulsed	2.52–2.90	15 mJ
RbCl:Li(F_A)	cw	2.70–3.30	10 mW
	pulsed	2.73–3.18	15 mJ
Organic Dye Laser			
polymeric host	pulsed	0.55–0.70[(a)]	≤ 150 mJ

(a) Tunable; several different polymer rods are needed to cover the wavelength range indicated.

Section 6.2

SEMICONDUCTOR LASERS

Introduction to the Table

Commercial semiconductor lasers (single diode and arrays), mode of operation (pulsed or cw), principal wavelengths, and representative outputs are given in Table 6.2.1.

Table 6.2.1
Commercial Semiconductor Lasers

Laser Material	Operation	Principal wavelengths (μm)	Output
GaN	pulsed	0.415	20 nJ
GaAlAs	cw	0.42, 0.43 (SH)	0.4–4.0 W
InGaAlP	cw	[0.63–0.68]	1–500 mW
	pulsed	0.68	≤ 10 J
GaAsP	cw	0.67	1–10 mW
	pulsed	0.67	3–10 J
GaAlAs	cw	[0.75–0.85]	1–200 mW
	pulsed	[0.75–0.85]	1–500 mJ
GaAlAs (array)	cw	[0.75–0.85]	10 W–40 W
	pulsed	[0.78–0.91]	0.1–30 J
GaAs	pulsed	0.904	_ 0.8 J
GaAs (array)	pulsed	0.904	_ 5 J
InGaAs	cw	0.905–0.98	0.02–1 W
	pulsed	0.905–0.98	10-6–1 J
InGaAs (array)	cw	0.91–0.98	30 W
InGaAsP	cw	1.27–1.33	0.1–3.0 W
	cw	1.52–1.58	0.5–100 mW
	pulsed	1.06–1.55	0.2 mJ
	pulsed	1.55	10-3–0.6 J
InGaAsP (array)	pulsed	1.55	2.5 J
Pb salts	cw	3.3–27	0.1–25 mW
	pulsed	3.3–25	< 2 J
Pb salts (77 K)	cw	2.9–3.6	1–5 mW

Section 6.3

DYE LASERS

Introduction to the Table

Wavelength ranges for commercial laser dyes, pump sources, and representative outputs are given in Table 6.3.1.

Lasing of organic dyes is dependent on the solvent, dye concentration, pumping source and rate, and other operating conditions. Relative energy outputs and tuning curves that may be obtained from commercially available pump sources and dyes are shown in Figures 6.3.1 – 6.3.12 (figures courtesy of Richard N. Steppel). The information is provided only as a guide and may not necessarily be extrapolated to systems other than those cited.

Table 6.3.1
Commercial Dye Lasers Arranged in Order of Wavelength

Wavelength (μm)	Pump source	Output
CW Lasers:		
0.22–0.39 (SH)	Ar ion laser	0.01 W
0.38–1.0	Ar ion laser	0.1–2 W
Pulsed Lasers:		
0.2–0.4 (SH)	Nd:YAG, excimer lasers	1–60 mJ
0.25–0.4 (SH)	coaxial flashlamp	0.1–0.9 J
0.3–0.9	linear flashlamp	0.5–3 J
0.32–1.0	excimer laser	10–150 mJ
0.36–0.95	nitrogen laser	0.1–150 mJ
0.4–1.0	Nd:YAG laser	5–200 mJ
0.44–0.8	coaxial flashlamp	< 1–30 J
0.53–0.9	Cu vapor laser	0.1– 2 mJ
0.695–0.905	Ti:sapphire laser	≤ 0.15 J
0.9–4.5 (R)	Nd:YAG laser	1–10 mJ

R - Raman shifted, SH - second harmonic.

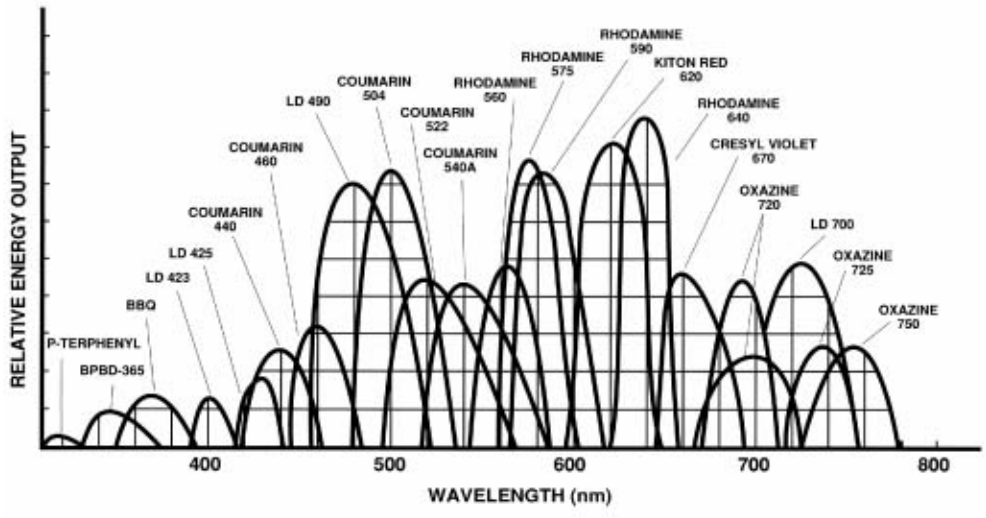

FIGURE 6.3.1 Tuning curves and relative energy outputs of various coaxial flashlamp pumped dyes. Data courtesy of Phase-R Corp., Box G-2, Old Bay Road, New Durham, NH.

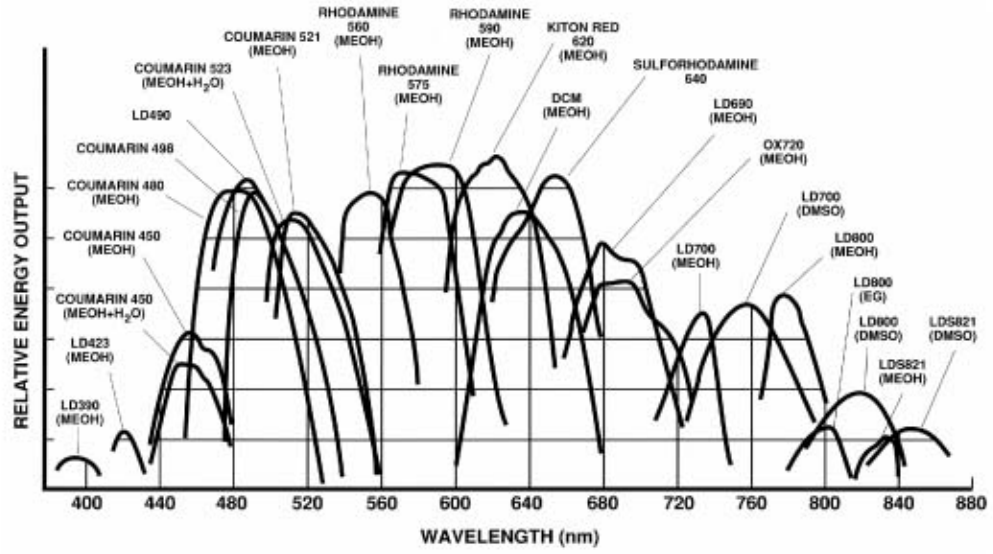

FIGURE 6.3.2 Tuning curves and relative energy outputs of various coaxial flashlamp pumped dyes. Data courtesy of Candela Laser Corp., 530 Boston Post Road, Wayland, MA.

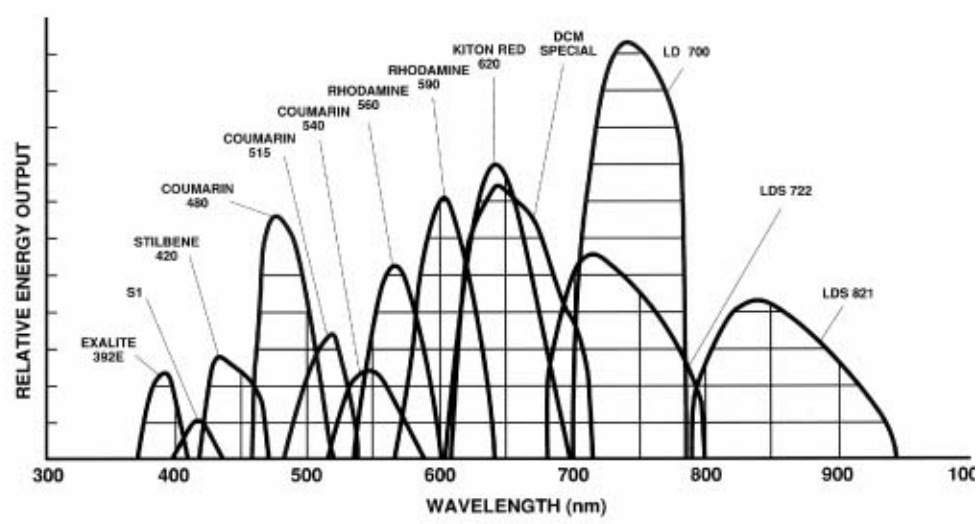

FIGURE 6.3.3 Tuning curves and relative energy outputs of various argon-ion and krypton-ion laser pumped dyes. Data courtesy of Coherent Inc., 3210 Porter Drive, Palo Alto, CA.

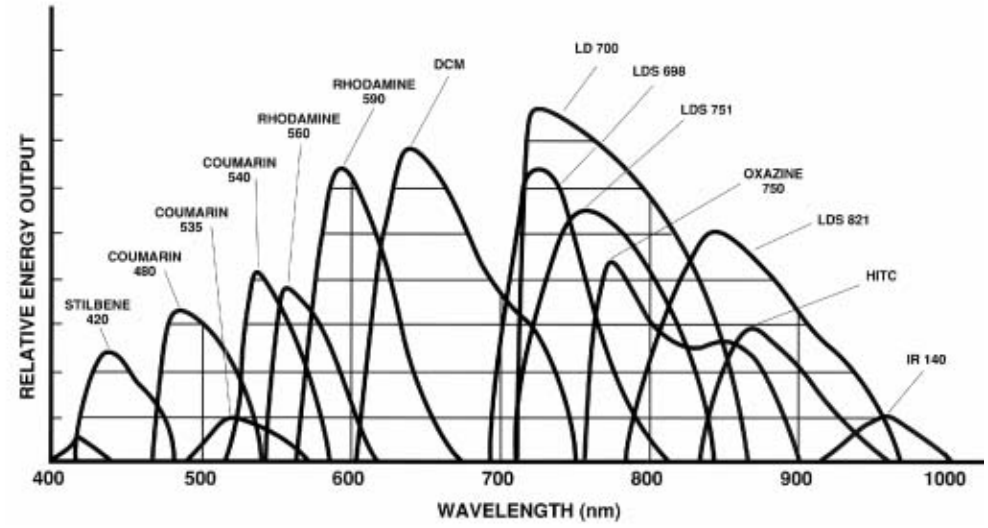

FIGURE 6.3.4 Tuning curves and relative energy outputs of various argon-ion and krypton-ion laser pumped dyes. Data Courtesy of Spectra-Physics Inc., 1250 Middlefield Road, Mountain View, CA.

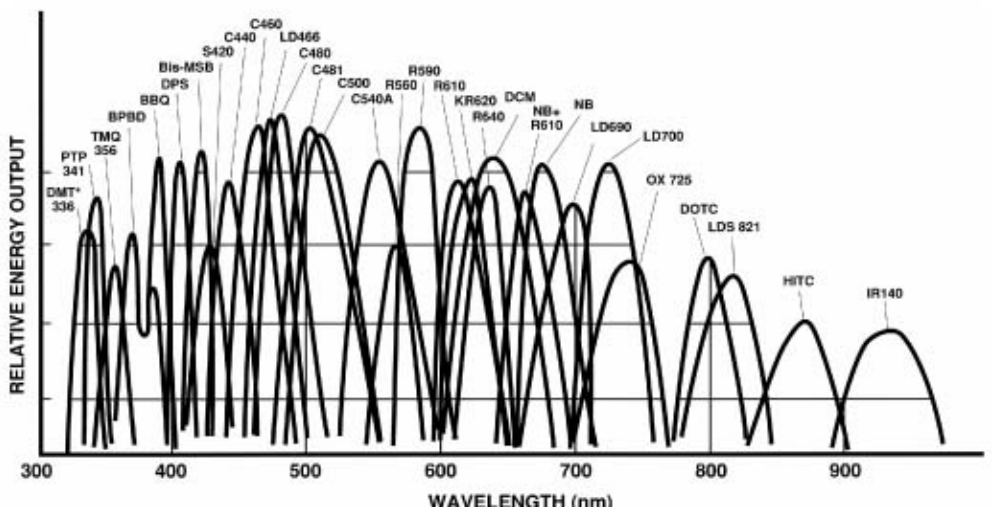

FIGURE 6.3.5 Tuning curves and relative energy outputs of various krypton fluoride and xenon chloride laser pumped dyes. Data courtesy of Lumonics, Inc., 105 Schneider Road, Kanata (Ottawa), Ontario, Canada.

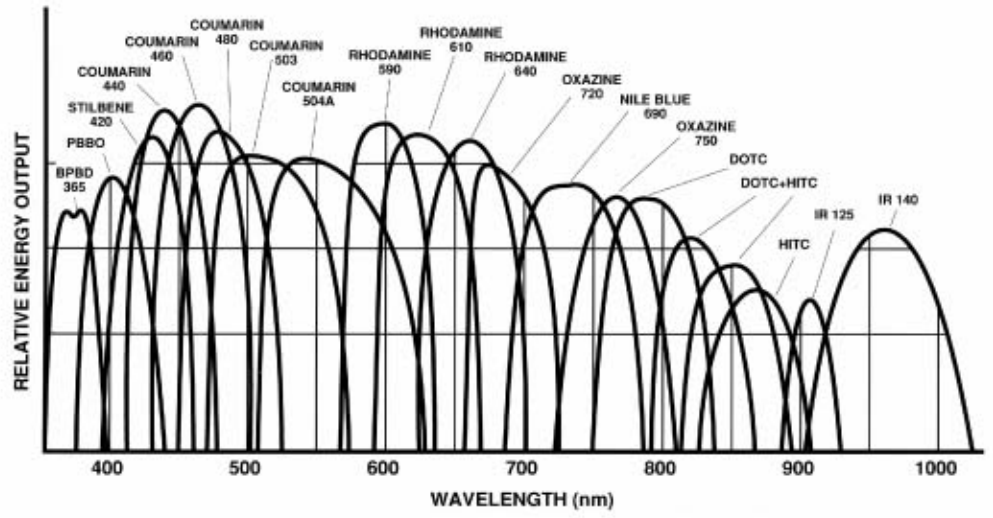

FIGURE 6.3.6 Tuning curves and relative energy outputs of various nitrogen laser pumped dyes. Data courtesy of Jobin Yvon, 16-18, rue du Canal B. P. 118, 91163 Longjumeau Cedex, France.

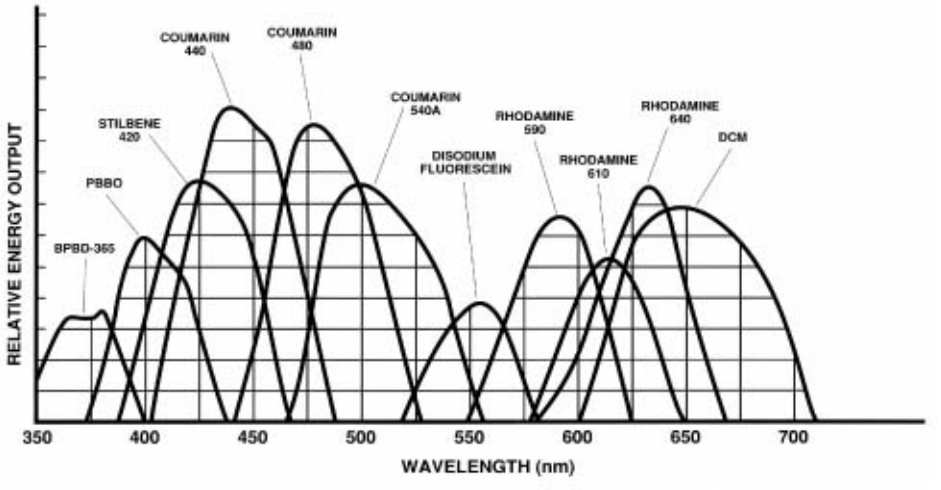

FIGURE 6.3.7 Tuning curves and relative energy outputs of various nitrogen laser pumped dyes. Data courtesy of Laser Science, Inc., 26 Landsdowne Street, Cambridge, MA.

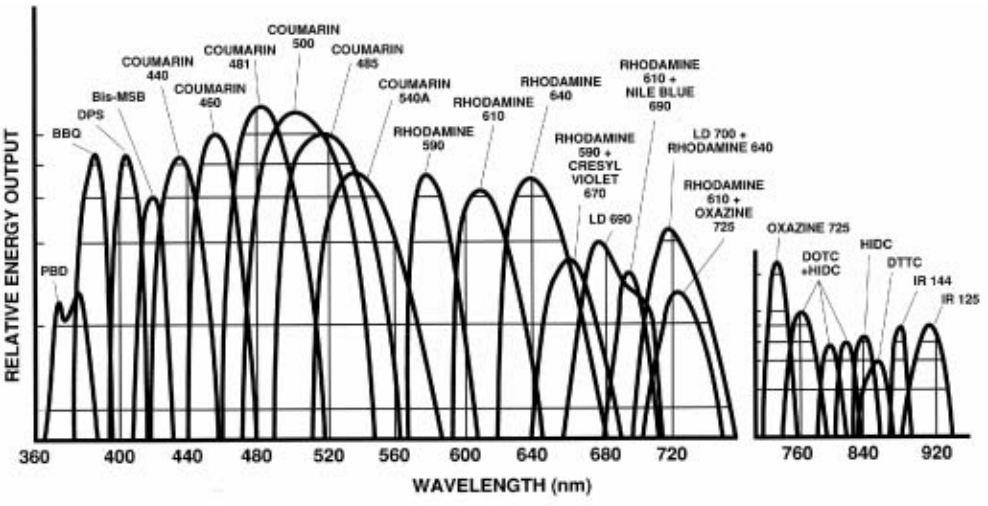

FIGURE 6.3.8 Tuning curves and relative energy outputs of various nitrogen laser pumped dyes. Data courtesy of Laser Photonics, Inc., 12351 Research Parkway, Orlando, FL.

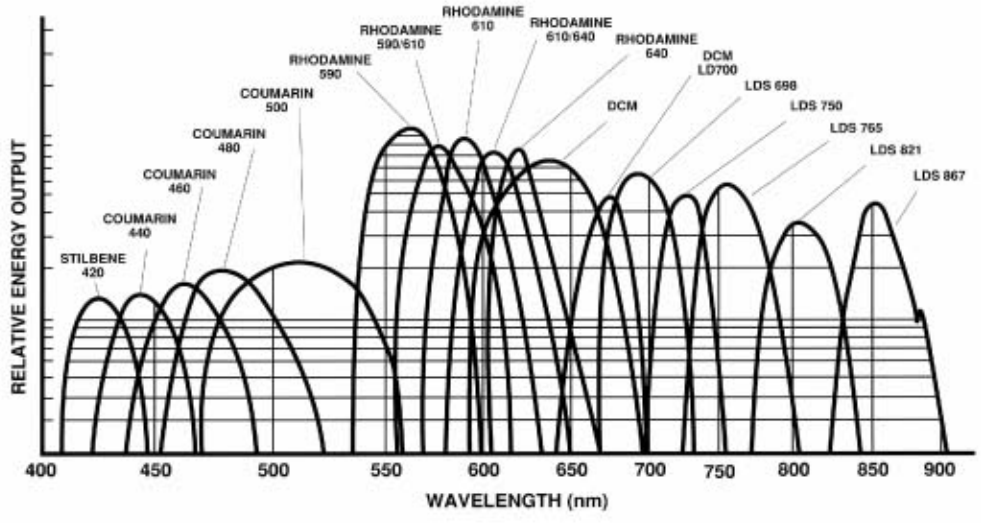

FIGURE 6.3.9 Tuning curves and relative energy outputs of various Nd:YAG laser pumped dyes. Data courtesy of Continuum, 3150 Central Expressway, Santa Clara, CA.

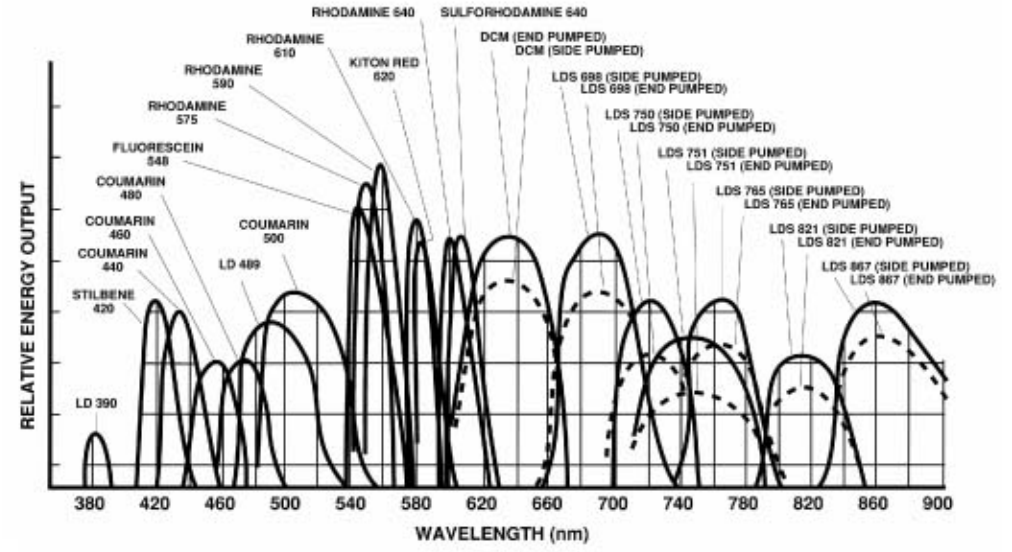

FIGURE 6.3.10 Tuning curves and relative energy outputs of various Nd:YAG laser pumped dyes. Data courtesy of Spectra-Physics/Quanta-Ray, 1250 Middlefield Road, Mountain View, CA.

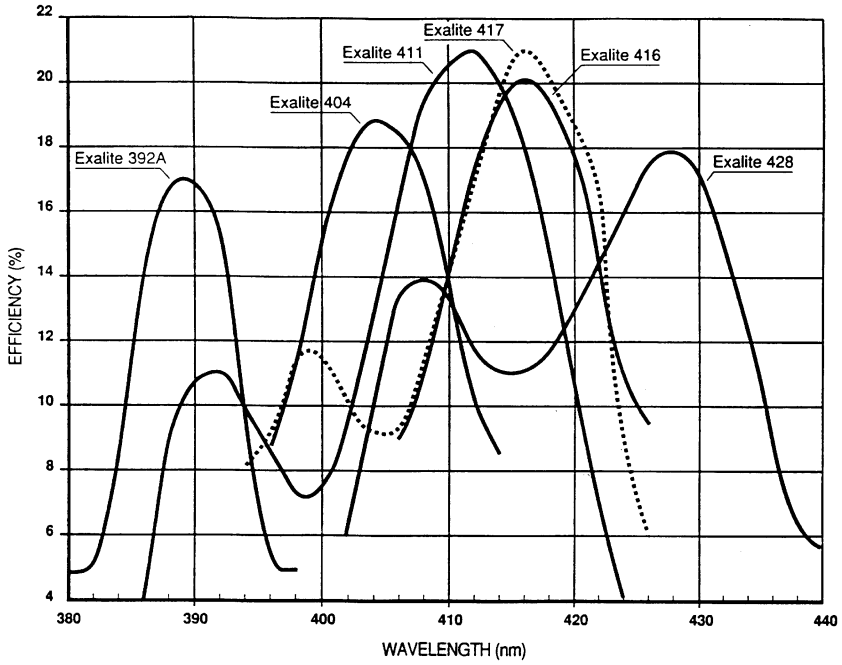

FIGURE 6.3.11 Tuning curves and efficiency of Exalite laser dyes (Exciton, Inc.) for Nd:YAG pumping at 355 nm. Data courtesy of Spectra-Physics/Quanta-Ray, 1250 Middlefield Road, Mountain View, CA.

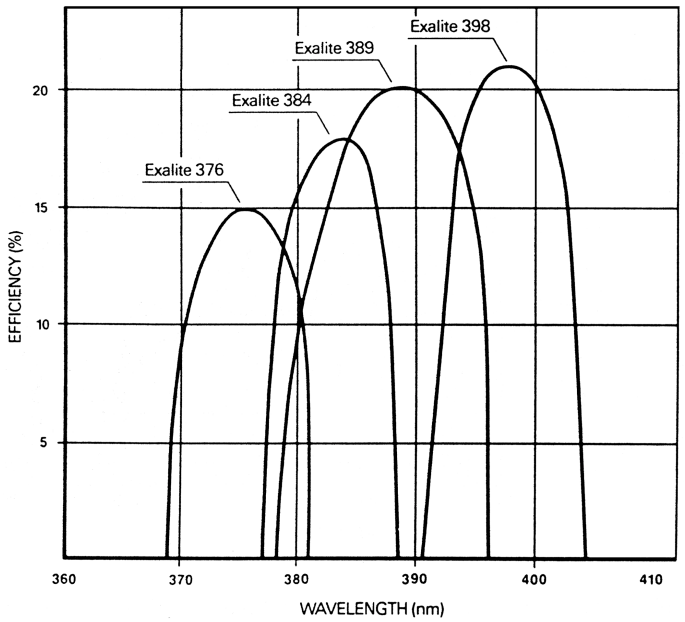

FIGURE 6.3.12 Tuning curves and efficiency of Exalite laser dyes (Exciton, Inc.) for Nd:YAG pumping at 355 nm. Data courtesy of Lumonics, Inc., 105 Schneider Road, Kanata (Ottawa), Ontario, Canada.

Section 6.4

GAS LASERS

Introduction to the Table

Commercial gas laser types, mode of operation (cw or pulsed), lasing wavelengths, and representative outputs are given in Table 6.4.1.

Table 6.4.1
Commercial Gas Lasers Arranged in Order of Wavelength

Laser Type	Operation	Wavelength(s) (μm)	Output
Helium-neon (He-Ne)	cw	0.5435	0.1–3 mW
	cw	0.5941	0.5–7 mW
	cw	0.6119	0.5–7 mW
	cw	0.6328	0.5–50 mW
	cw	1.152	1–13 mW
	cw	1.523	0.5–1 mW
	cw	3.391	1–40 mW
Helium-cadmium (He-Cd)	cw	0.325	1–100 mW
	cw	0.4416	10–200 mW
Helium-silver ($He\text{-}Ag^+$)	cw	0.2243	1 mW
	pulsed	0.2243	0.1 J
Helium-gold ($He\text{-}Au^+$)	cw	[0.282–0.292]	3 mW
	pulsed	[0.282–0.292]	0.3 J
Neon-copper ($Ne\text{-}Cu^+$)	cw	[0.248–0.270]	3 mW
	pulsed	[0.248–0.270]	0.3 J
Xenon-helium (Xe-He)	cw	2–4 μm	1–600 mW
	pulsed	2–4 μm	0.5 J
Molecular Lasers:			
Carbon dioxide (CO_2)[(a)]	cw	10.6	1 W–10 kW
	pulsed	10.6 (other lines from 9.2 to 11.4)	100 mJ–3 kJ

Table 6.4.1—*continued*
Commercial Gas Lasers Arranged in Order of Wavelength

Laser Type	Operation	Wavelength(s) (μm)	Output
Carbon monoxide (CO)	cw, pulsed	several lines between 5 and 7 μm	1–35 W
Iodine (I_2)	pulsed	1.315	≤ 1–3 J
Nitrogen (N_2)	pulsed	0.3371	0.1–10 mJ
Nitrous oxide (N_2O)	cw pulsed	10.65 (other lines 10.3 to 11.1) 10.65 (other lines 10.3 to 11.1)	15 W 1 mJ
Metal Vapor Lasers:			
Copper (Cu)	cw pulsed	0.5105, 0.5782 0.5105, 0.5782	100 W 1–20 mJ
Gold (Au)	cw pulsed	0.628 0.628	2 W 0.2–0.6 mJ
Ion Lasers:			
Neon (Ne^+)	cw	0.3324 (other lines–0.3392, 0.3378, 0.3345, 0.3713, 0.373)	1 W
Argon (Ar^+)	cw, pulsed	0.4880, 0.5145 (other lines–0.351, 0.4545, 0.4579, 0.4765, 0.4965, 0.5017, 0.5287)	5 mW–50 W
Krypton (Kr^+)	cw, pulsed	0.6471 (other lines–0.3375, 0.3564,0.4762, 0.5208, 0.5309, 0.5682, 0.6764, 0.7525, 0.7993)	0.1–6 W
Argon-Krypton (Ar^+-Kr^+)	cw	many lines between 0.34–0.80 several lines between 0.458–0.676	1–3 W 0.2–10 W
Xenon (Xe^{3+})	pulsed	0.5395	0.6 J
Excimer Lasers:			
Fluorine (F_2)	pulsed	0.157	1–60 mJ

Table 6.4.1—*continued*
Commercial Gas Lasers Arranged in Order of Wavelength

Laser Type	Operation	Wavelength(s) (μm)	Output
Argon fluoride (ArF)	pulsed	0.193	3–700 mJ
Krypton chloride (KrCl)	pulsed	0.222	0.3–1.2 J
Krypton fluoride (KrF)	pulsed	0.248	5 mJ–2 J
Xenon chloride (XeCl)	pulsed	0.308	0.1–0.3 J
Xenon fluoride (XeF)	pulsed	0.351	2 mJ–0.5 J
Chemical Lasers:			
Hydrogen fluoride (HF)	cw	2.6-3.0	2–1000 W
	pulsed		50 mJ–3 J
Deuterium fluoride (DF)	cw	3.6-4.0	1–100 W
	pulsed	3.6-4.0	30 mJ–3 J
Far Infrared Lasers:			
Methanol (CH_3OH)	pulsed, cw	37.9, 70.5, 96.5, 118, 571, 699 other lines from 37 to 1224 μm(b)	< 1 W
Methyl fluoride (CH_3F)	pulsed, cw	496, 1222 μm	< 1 W
Other molecules(b)	cw	lines from ~40 to 1000 μm	0.1–1 W
	pulsed	lines from ~40 to 1200 μm	$\leq$ 750 mJ

(a) Operating configurations include axial gas flow (20 W–5 kW), transverse gas flow (500 W–15 kW), sealed tube (3 W–100 W), TEA (tranverse excited, atmospheric pressure), and waveguide (0.1–50 W).

(b) Methanol (fully deuterated) (CD_3OD): 41.0, 184, 229, 255 μm.
Methylamine (CH_3NH_2): 147.8 μm, other lines from 100 to 351 μm.
Methyl iodide (fully deuterated) (CD_3I): 461, 520 μm; other lines from 272 to 1550 μm.
Formic acid (HCOOH): 432.6 μm, other lines from 134 to 1213 μm.
Difluoromethane (CH_2F_2): 375, 889, 1018 μm.