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List of Abbreviations

ALU	Arithmetic Logic Unit
BPM	Beam Propagation Method
CW	Continuous Wave
DC	Directional Coupler
DLSPP	Dielectric Loaded Surface Plasmon Polariton
FWM	Four-wave Mixing
IGMPW	Index Guided Multimode Plasmonic Waveguide
MFOD	Multifunctional Optical Device
MIM	Metal-Insulator-Metal
MMI	Multimode Interference
MZ	Mach-Zehnder
MZ-MMI	Mach-Zehnder based Multimode Interference
NDCMMI	Nonlinear Directional Coupler based Multimode Interference
OTMI	Optically-controlled Two-mode Interference
PhCWG	Photonic Crystal Waveguide
SEIM	Simple Effective Index Method
SEIM-x	Simple Effective Index Method along x-direction
SEIM-y	Simple Effective Index Method along y-direction
SOA	Semiconductor Optical Amplifier
SPP	Surface Plasmon Polariton
SPTMI	Surface plasmonic Two-mode Interference
TE	Transverse Electric
TM	Transverse Magnetic
TMI	Two-mode Interference

List of Symbols and Notations

α	Bending loss coefficient
α_P	Propagation loss coefficient
α_1	Fraction of input power transferred to output access waveguide-3 in a optical power splitter
α_2	Fraction of input power transferred to output access waveguide-4 in a optical power splitter
β_m	Propagation constant of mth mode propagating in SPTMI coupler
$\beta_m(n_1, n_2(E), n_m)$	Propagation constant of mth mode in SPTMI coupler as a function of refractive indices n_1, $n_2(E)$ and n_m
$\beta_m(n_2(E))$	Propagation constant of mth mode in SPTMI coupler when optical pulse of energy E is applied
$\beta_m(n_2(0))$	Propagation constant of mth mode in SPTMI coupler when no optical pulse is applied
β_m^r	Real part of propagation constant of mth mode propagating in SPTMI coupler
$\beta_m^r(n_1, n_2(E), n_m)$	Real part of propagation constant of mth mode in SPTMI coupler as a function of refractive indices n_1, $n_2(E)$ and n_m
$\beta_m^r(n_2(E))$	Real part of propagation constant of mth mode in SPTMI coupler when optical pulse of energy E is applied
$\beta_m^r(n_2(0))$	Real part of propagation constant of mth mode in SPTMI coupler when no optical pulse is applied
β_m^{im}	Imaginary part of propagation constant of mth mode propagating in SPTMI coupler

$\beta_m^{im}(n_1, n_2(E), n_m)$	Imaginary part of propagation constant of mth mode in SPTMI coupler as a function of refractive indices n_1, $n_2(E)$ and n_m
$\beta_m^{im}(n_2(E))$	Imaginary part of propagation constant of mth mode in SPTMI coupler when optical pulse of energy E is applied
$\beta_m^{im}(n_2(0))$	Imaginary part of propagation constant of mth mode in SPTMI coupler when no optical pulse is applied
β_e	Propagation constant of even mode in a directional coupler
β_o	Propagation constant of odd mode in a directional coupler
δw	Deviation of width in SPTMI coupler
$\Delta\beta_{m,r}^{eff}(n_2(E))$	Change in real part of propagation constant of mth order mode ($m = 0, 1$) due to application of optical pulse energy
$\Delta n_{m,r}^{eff}(E)$	Effective real refractive index change of mth order mode ($m = 0, 1$) due to application of optical pulse energy
$\Delta n_2(E)$	Change in refractive index of GaAsInP cladding due to application of optical pulse
Δn	Index contrast between core and cladding in a waveguide
$\Delta\Phi_T(E)$	Phase difference between the fundamental and first order modes at the end of coupling region after application of optical pulse of energy E
$\Delta\Phi(E)$	Additional phase shift induced between the excited SPP modes due to application of optical pulse of energy E
ϵ	Dielectric constant of any medium
ϵ_0	Dielectric constant of free space
ϵ_d	Dielectric constant of pure dielectric medium
ϵ_m	Dielectric constant of metal
ϵ_i(i=1,2,3)	Dielectric constant of ith medium
$\epsilon_{eff}^{/}$	Effective dielectric constant of dielectric medium with refractive index n_1 and width W_T sandwiched between layers of dielectric medium with refractive index $n_2(E)$

η_{core}	Optical power launching efficiency to silicon core of SPTMI waveguide coupler
η_{clad}	Optical power launching efficiency to the nonlinear GaAsInP cladding of SPTMI waveguide coupler
κ	Coupling coefficient in directional coupler
λ	Wavelength of incident light
λ_{spp}	Wavelength of surface plasmon polariton wave
ω	Angular velocity of incident light
ϕ	Bending angle
A_{clad}	Effective cross sectional area of GaAsInP cladding
A_{core}	Cross sectional area of access waveguide core
$a(z)$	Amplitude of mode in waveguide-1 in directional coupler
a_e	Amplitude of even mode
a_o	Amplitude of odd mode
$b(z)$	Amplitude of mode in waveguide-2 in directional coupler
b_I	Normalized guide index
b_i	Mode field excitation coefficient of the ith mode in MMI coupler
b_m^T	Field excitation coefficient for the mth order mode in the SPTMI coupler
c	Velocity of light
$c_{M,i}$	Contribution of ith mode to Mth output access waveguide
$c_{3,m}^T$	Coefficient of field contribution of mth mode for third output access waveguide
$c_{4,m}^T$	Coefficient of field contribution of mth mode for fourth output access waveguide
C	Coupling coefficient estimated from coupled mode theory
d	Half of separation between waveguides in directional coupler
E	Energy of optical pulse applied to obtain index modulation in SPTMI coupler
$E_x(z)$	Electric field component in the x-direction
$E_y(z)$	Electric field component in the y-direction
$E_z(z)$	Electric field component in the z-direction

h	Coupling gap in DC and MMI coupler
$H(y, 0)$	Input field incident on access waveguide in MMI coupler
$H(y, L)$	Output field at $Z = L$ in MMI coupler
$H_M(y, L)$	Output field at $Z = L$ at Mth output access waveguide in MMI coupler
$H_{M,i}(y, L)$	Field contribution of ith mode to Mth output access waveguide
$H_i(y)$	Mode field distribution of the ith mode in MMI coupler
$H_1(x, 0)$	Input field launched through input access waveguide-1 at $z = 0$
$H_3(x, L, E)$	Output fields at output access waveguide-3 at $z = L$
$H_4(x + w, L, E)$	Output fields at output access waveguide-4 at $z = L$
$H_5(L_1, E)$	Field at access waveguide-5
$H_6(L_2, E)$	Field at access waveguide-6
$H_7(L_3, E)$	Output field at access waveguide-7
$H_8(L_3, E)$	Output field at access waveguide-8
$H_m(x)$	Mode field of the mth excited mode in TMI region at $z = 0$ $(m = 0, 1)$
$H_x(z)$	Magnetic field component in the x-direction
$H_y(z)$	Magnetic field component in the y-direction
$H_z(z)$	Magnetic field component in the z-direction
H_S	Separation of bent access waveguides in SPTMI coupler
H_T	Bending height of bent access waveguides
k_0	Wave vector in free space
k_1	Wave vector in medium 1
k_2	Wave vector in medium 2
k_3	Wave vector in medium 3
k_d	Wave vector in dielectric medium
k_m	Wave vector in metallic medium
$k_i(i = 1, 2, 3)$	Wave vector in ith medium
L	Length of coupling region in SPTMI waveguide coupler
L_π	Beat length
L_A	Width of PbS doped Silica absorber in cascaded structure

L_C	Coupling length
L_D	Device length of basic SPTMI waveguide coupler
L_M	Distance of separation between the two mirrors in mode locked laser
L_T	Transition length of access waveguides in SPTMI waveguide coupler
$L_{P,m}$	Propagation length of mth mode in SPTMI coupler
$L_{cascaded}$	Device length of cascaded structure for implementation of NOR, NAND and XOR logic gates
L_1	Length of coupling region of first SPTMI waveguide coupler in cascaded structure
L_2	Length of coupling region of second SPTMI waveguide coupler in cascaded structure
L_3	Length of coupling region of third SPTMI waveguide coupler in cascaded structure
m	Mode number
n_1	Refractive index of silicon core in SPTMI waveguide coupler
$n_2(0)$	Refractive index of GaAsInP cladding in SPTMI waveguide coupler before application of optical pulse
$n_2(E)$	Refractive index of GaAsInP cladding in SPTMI waveguide coupler after application of optical pulse
n_m	Refractive index of silver cladding in SPTMI waveguide coupler
$n_{m,real}$	Real part of refractive index of silver
$n_{m,im}$	Imaginary part of refractive index of silver
n_{nl}	Nonlinear coefficient of GaAsInP
$n_{1,eff}$	Effective refractive index of medium with refractive index n_1 and thickness t sandwiched between medium with refractive index n_m
$n_{2,eff}$	Effective refractive index of medium with refractive index $n_2(E)$ and thickness t sandwiched between medium with refractive index n_m
$n_{eff}^{/}$	Effective refractive index of medium with refractive index n_1 and width W_T sandwiched between medium with refractive index $n_2(E)$
$n_{m,r}^{eff}$	Effective refractive index for mth mode propagation in SPTMI coupler

$n_{m,r}^{eff}(0)$	Effective refractive index for mth mode propagation in SPTMI coupler before application of optical pulse
$n_{m,r}^{eff}(E)$	Effective refractive index for mth mode propagation in SPTMI coupler after application of optical pulse
$n_i(i = 1, 2, 3, 4)$	Refractive index of dielectric media
N	Number of oscillating modes in mode locked laser
NA_{core}	Numerical aperture of silicon core in SPTMI coupler
NA_{clad}	Numerical aperture of GaAsInP cladding in SPTMI coupler
P_1	Power at access waveguide-1
P_2	Power at access waveguide-2
P_3	Power at access waveguide-3
P_4	Power at access waveguide-4
P_5	Power at access waveguide-5
P_6	Power at access waveguide-6
P_7	Power at access waveguide-7
P_8	Power at access waveguide-8
P_M	Power at Mth output access waveguide in MMI coupler
P_C	Power of optical pulse at cladding of SPTMI waveguide coupler
P_{C1}	Power of optical pulse at cladding of first SPTMI waveguide coupler in cascaded structure
P_{C2}	Power of optical pulse at cladding of second SPTMI waveguide coupler in cascaded structure
P_{in}	Power incident on a bent waveguide
P_{out}	Power at output end of a bent waveguide
R	Bending radius of access waveguides in SPTMI coupler
r	Radius of optical fiber used to launch optical power in SPTMI coupler
S	Arc length of S-bent waveguide
t	Core thickness in SPTMI coupler
t_1	Core thickness of first waveguide in directional coupler
t_2	Core thickness of second waveguide in directional coupler

T_P	Full width at half maximum of optical pulse applied at GaAsInP cladding
T_B	Bending loss in a waveguide with single bend
T_S	S-bending loss
T_R	Cavity round trip time in mode locked laser
V_I	Normalized frequency
w	Core width of access waveguides in SPTMI coupler
w_1	Core width of first waveguide in directional coupler
w_2	Core width of second waveguide in directional coupler
W_A	Width of PbS doped Silica absorber in cascaded structure
W_C	Width of GaAsInP cladding in SPTMI coupler
W_e	Effective width of coupling region in MMI waveguide
w_{MMI}	Width of core in MMI coupler
w_P	Width of optical pulse coupling channels in cascaded structure
W_T	Core width of silicon core in SPTMI coupler